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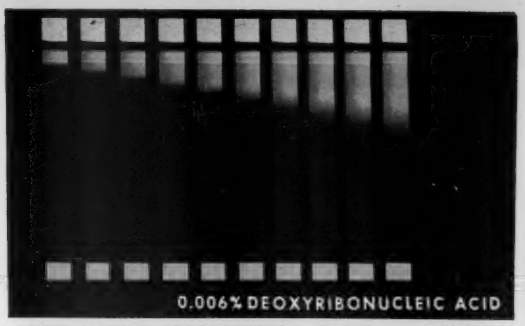

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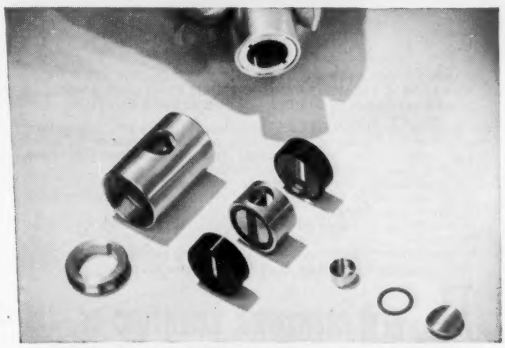

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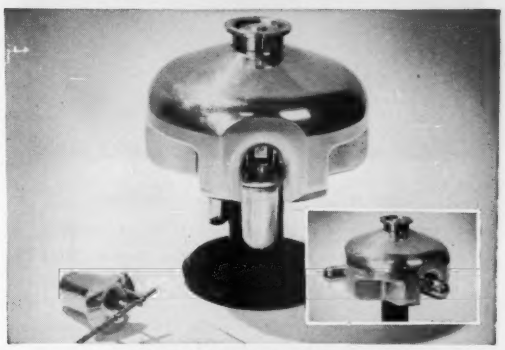

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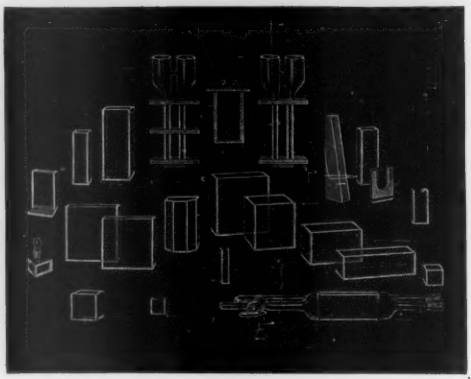

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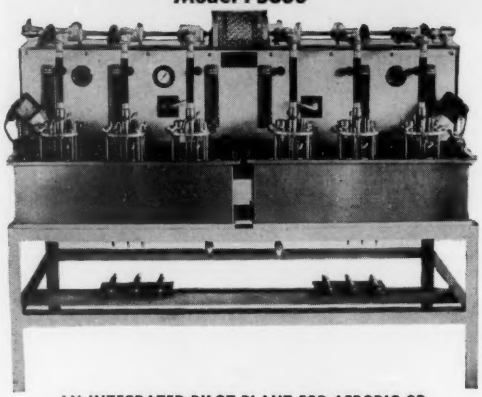

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Social Responsibility of Science

On page 143 appears a report of the Association's Interim Committee on the Social Aspects of Science, a committee that was established by the Council a year ago. The specific problems of the relations between science and society that are discussed in the report help to define a prior and more general question: Under what circumstances and in what ways is it appropriate for an organized body of scientists to participate actively in the determination of social policy? This question—it should be emphasized—is asked of organizations, not of their individual members.

In a democratic society, an individual scientist enjoys the freedom accorded all citizens to express his judgment on social issues and to work for the social conditions he considers desirable. The committee report asserts that an organized body of scientists also has a right to express a judgment on public issues and to work for those conditions that its members consider desirable.

Some observers would deny such a right to scientific organizations. They argue along these lines: Members of scientific organizations are experts in science, but not in public affairs. They have organized to work on scientific matters, not on public issues. If organized science attempts to influence general policy, it is going beyond its realm of special competence, and its efforts will inevitably be misunderstood. Efforts to *influence* will be interpreted as attempts to *control*. Confusion will result, and science will be discredited.

Supporters of the other side of the question reply that other organized groups unhesitatingly speak out as active segments of public opinion without being inhibited by the fact that their areas of special interest and competence constitute only part of the proper basis for determining policy. Given this situation, the argument runs, scientific organizations have an obligation to present their recommendations. If they do not, scientific considerations will be inadequately represented in the formulation of policy, and the long-run interests of society will thereby be damaged.

It will be helpful to have active consideration of the proper role of scientific organizations in this regard, for the Association's own policy is not clear. At its 1956 meeting, the Council instructed the committee to continue to study the issues involved and asked for specific recommendations at the 1957 meeting. In so doing, the Council implied that the AAAS cannot remain aloof from questions of social policy. If that is agreed, it still remains to be decided how actively and in what ways the Association should be involved. There is a graded series of possibilities:

Scientific organizations should point out the scientific evidence that is relevant to a policy issue.

They should go farther and point out the implications of the scientific evidence.

They should go still farther and recommend the actions that seem, from the point of view of science, to be most desirable.

How far along this series is it proper for an organized body of scientists to go?—D. W.

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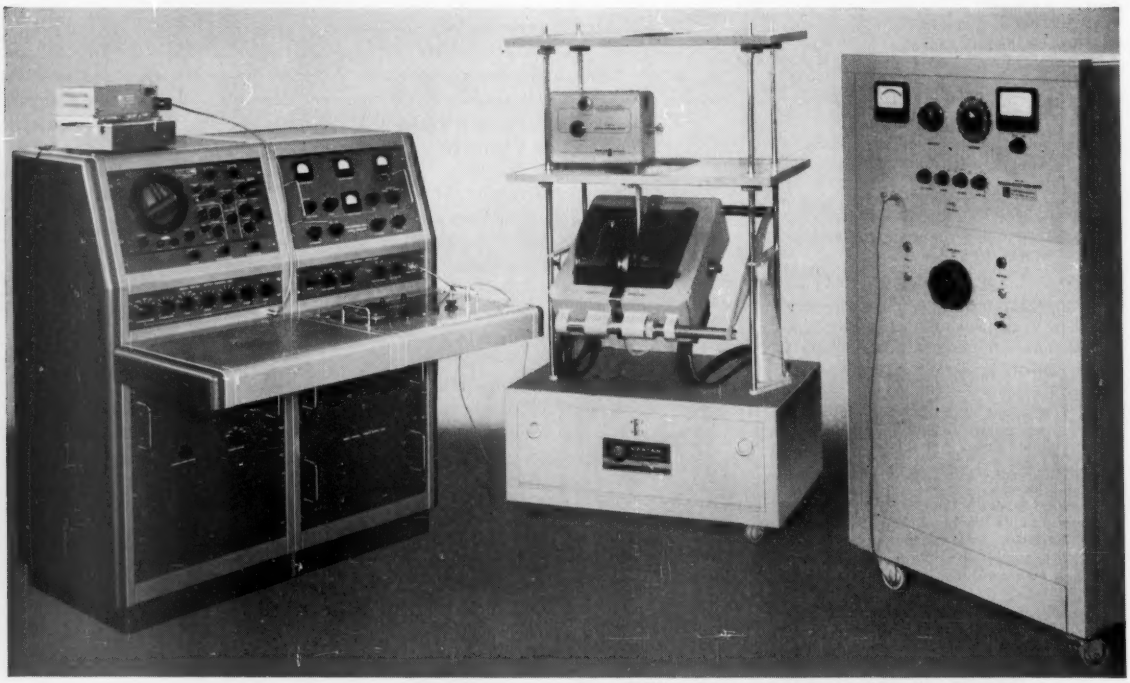

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Social Aspects of Science

Preliminary Report of AAAS Interim Committee

The council of the American Association for the Advancement of Science, at its 1955 meeting, resolved to establish an "Interim Committee on the Social Aspects of Science." During the past year this committee has made a preliminary study of the present state of science in the United States and its relation to social forces and issues. The committee found that even a cursory examination of this question leads to a serious conclusion: that there is an impending crisis in the relationships between science and American society. This crisis is being generated by a basic disparity. At a time when decisive economic, political, and social processes have become profoundly dependent on science, the discipline has failed to attain its appropriate place in the management of public affairs.

The committee believes that this question demands the most urgent attention of the AAAS and of scientists generally. The present interim report is not intended as a complete consideration of the many interrelated problems encompassed by the area which the committee has studied. Rather, the report represents a sampling of some of the issues which the committee has found to serve as useful points of departure in developing an analysis of the situation. Because of the importance of this matter, the committee believes that any decision on the manner in which the AAAS can best deal with it should be based on extended and broadly conducted discussion among natural and social scientists and other interested persons. The report which follows is intended as one means of initiating this discussion.

Such an undertaking comes at an opportune time. We are at the start of a period in which science holds the promise of making unprecedented improvements in the condition of human life. Any action taken now to assist the orderly growth and beneficial use of science will be of lasting significance.

New Scientific Revolution

A cursory examination shows that society has become far more dependent on science than ever before for the following reasons.

Accelerated growth of scientific activity. The volume of scientific research and development conducted in this country has been increasing at an astonishing rate. In 1930, expenditures for science were estimated at $166 million; in 1953, the amount was more than $5 billion. Allowing for the change in the value of the dollar, this represents approximately a 15-fold increase in research expenditures over the 23-year period. The number of active scientists in the United States in 1930 was 46,000; the present number is probably about 250,000. All estimates of future needs for scientific research and personnel indicate that this growth will continue at an accelerated pace. This rate of growth sets scientific activity apart as the second most rapidly expanding sector of our social structure, military activities being first.

Increased use of scientific knowledge. It is characteristic of the present era that the previously formidable gap between scientific knowledge and its application to practical problems has become considerably reduced. It is now commonplace that calculations based on physical theory move quickly from the scientist's laboratory across the engineer's drafting board and on to actual industrial production. Since 1940 we have experienced a series of classic examples of almost immediate conversion of a scientific advance to a process of large practical impact upon society: antibiotics, synthetic polymers, nuclear energy, transistor electronics, microwave techniques, electronic computers. The greatly narrowed gap between laboratory and factory results from a distinctively new role of research in industry. Scientific investigations were previously regarded by industry as a kind of exotic garden to be cultivated in the hope of producing an occasional rare fruit. In contrast, research has now become a deliberate instrument of industrial development; scientific investigations are consciously undertaken as a means of achieving desired economic gains or, as in several notable industrial laboratories, for the purpose of contributing to our fund of basic scientific knowledge.

Recent advances in science have also created completely new industries. Four major industries—chemical, electronic, nuclear energy, and pharmaceutical—represent direct extensions of laboratory experience to an industrial scale. This type of direct transformation of scientific experience to industrial operation is probably unique in human history. Earlier industrial developments were based more on empirical experience than on laboratory science.

Social Position of Science

Science is but one sector of our culture. It is one of the institutions of society, and to a considerable degree society itself governs the development of science. In the present situation, social forces influence the development of science in the following key ways.

Social demand for technologic advances. From the evidence already cited it is clear that there is a strong social demand for at least some kinds of scientific progress. The fact that industry has made unprecedented investments in research is practical evidence that this type of scientific work is seen as a desirable activity by industrial managers. Government scientific activity, which

Members of the committee are Ward Pigman, associate professor of biochemistry, University of Alabama Medical Center, *chairman*; Barry Commoner, professor of botany, Washington University; Gabriel Lasker, associate professor of anatomy, Wayne State University; Chauncey D. Leake, professor of pharmacology, Ohio State University; Benjamin H. Williams, Industrial College of the Armed Forces.

perhaps reflects a wider range of social forces, has also been very intense in the past 20 years. Accelerated support for scientific research is evident from the increased scale of military research, the growing activities of the National Science Foundation, the greatly increased support for medical research by the National Institutes of Health, and the increasing share of philanthropic funds from private agencies now devoted to research on health and social problems. The following generalizations may be made concerning the distribution of the enhanced research support now enjoyed by American science.

1) The major part of research support goes into applied research and development rather than into basic science. In industrial research, the ratio is about 97/3; in universities, about 50/50; in federal agencies (including support for research done elsewhere) about 90/10.

2) Support is heavily slanted toward physical sciences. In 1954, federal research support was divided as follows: physical sciences, 87 percent; biological sciences, 11 percent; social sciences, 2 percent. Industrial research is at least as heavily weighted in this direction.

3) At present a very large part of our total research activities are for military purposes. Of the estimated federal expenditures for research in 1957 ($2.5 billion), about 84 percent is earmarked for matters related to national security.

4) Colleges and universities, which are the site of much of our basic research activities, have become dependent on federal funds for the greater portion of their research support (60 to 70 percent in 1954).

Some of the effects of these factors upon the character of scientific research are discussed in the section on "Internal situation in science."

Public interest in science. There are indications that the public interest in science is not commensurate with the important role of science in society.

1) Shortage of scientific personnel: We face a major crisis with respect to present and future shortages of scientific personnel. In effect, this means that the social environment in the United States does not elicit a maximum interest in science on the part of those individuals who have the capability of doing scientific work, or that our social organization does not permit them to receive the necessary training. This problem is closely connected with the more general question of the present state of public education in the United States. The content of public education has been subjected to a good deal of criticism recently, especially with regard to science and mathematics. Many scientists feel that an official state requirement for graduation from high school which calls for 1 year of "general" mathematics and for 1 year of "general" science cannot be regarded as proper recognition of the importance of science.

2) Attitudes toward scientific work: To some degree the foregoing difficulties reflect a broader problem—that is, a traditional disregard for abstract thinking. More than a century ago De Tocqueville observed, "Hardly anyone in the United States devotes himself to the theoretical and abstract portion of human knowledge." He said that the immediately practical aspects of life were, however, fully appreciated. The same generalization appears to be true today. So-called "practical" men of public affairs and business frequently disregard the advice of scientists and prefer instead to rely on "common sense," but the latter is often construed to mean what Einstein has called "a deposit of prejudices laid down in the mind prior to the age of 18." This problem, particularly as it relates to a lack of interest in scientific careers, has attracted considerable attention of late. Recent surveys indicate that the general attitude exemplified by popular epithets such as "eggheads" and "longhairs" is well rooted in the opinions of young people.

3) Science in the public press and other media: By all standards, science receives an unduly small share of the budget of newspaper space or broadcasting time. The number of books and magazines devoted to disseminating public information about science is correspondingly small. The immediate reasons for this state of affairs are manifold. It is clear, however, that the situation reflects a rather low level of interest in science on the part of the public, or, more probably, of those who attempt to judge the public mind for purposes of directing the media of information.

Internal Situation of Science

How has its recently accelerated rate of growth and the general nature of the social influences upon it affected the character of American science? Some brief and approximate answers may be made.

Unbalanced growth. The growth of our scientific organization has not been an orderly process. Growth has been based less on internal needs of science than on the interest of external agencies in possible practical results. In a sense, the speed and direction of the development of science has been determined by the users of science rather than the practitioners of science. Agencies which use scientific knowledge (for example, industrial management, military establishments, medical agencies) have undertaken to encourage, and pay for, scientific research of a sort which seems to promise information that might be useful to their own specific purposes. This disproportionate growth of the physical sciences as compared with biological and social sciences to some degree reflects the interests and superior financial resources of the industrial and military agencies that support science.

The effects of this unbalanced development are already being felt. Generally speaking, we sometimes find ourselves embarking upon new ventures, based on advances in chemistry and physics, before we are adequately informed about their consequences on life or on social processes. Some of the resultant difficulties which we have already made for ourselves are described in the section on "Major social issues of scientific origin: signs of trouble."

It should be recalled that this unbalanced growth takes place within the framework of a shortage of personnel. This situation has very naturally given rise to a somewhat disorganized competition for students, which further accentuates the disparate pattern of development of the various sciences.

Inadequate progress in basic research. It is well known that the creative source of all technologic advance is the free inquiry into natural phenomena that we call basic, or "pure," science. However, as has already been indicated, the great bulk of our present research activities represent the development of practical applications of the knowledge generated by previous advances in pure science. It has been pointed out repeatedly that many of our current technologic advances are based on the application of accumulated basic knowledge which is perhaps 20 to 30 years old. The progress of basic science does not appear to be keeping pace with the development of applied science. Some observers even feel that there has been an absolute decline in the amount of highly creative research of the type that leads to major advances in our knowledge of nature. They point out that our present understanding of the structure of atoms and molecules and of the behavior of living cells goes back to great illuminating propositions that are 25 years or more old.

Difficulties in scientific communication. New information is the major goal of scientific research, and communication of information is vital for all scientific progress. However, the rapid, rather disordered growth of science has placed a severe strain on the channels of scientific communication.

1) Communication among the divisions of science: The problem of adequate dissemination of the results of current research has become a matter of great concern. The growth of our research establishment and the resulting

increase in the numbers of scientific communications have made the problem of "keeping up with the literature" quite serious. It is now widely recognized by scientists that the existing system of publication and distribution does not fill their needs. Published articles and monographs have not kept up with the current knowledge in many fields. The number of journals is insufficient (publication delays of 1 year are common) and methods of abstracting, indexing, and reviewing are inadequate. It is becoming rapidly more difficult for scientists to find out what their colleagues know. The situation is particularly bad with respect to articles printed in foreign languages (Russian, especially) which investigators are too frequently incapable of reading. Some observers have already urged the establishment of scientific information centers from which subscribers could receive transmitted reproductions of teletyped abstracts obtained by electronic scanning devices. Such centers would require government investment of about $150 million. That proposals of this magnitude are under current discussion is an indication of the severity of this problem.

Proper communication among scientists is not, however, merely a matter of developing proper recording, cataloging, and searching devices. Face-to-face meetings, which bridge the barriers of specialization, are an obvious necessity for the ordered growth of human knowledge. There is a widespread feeling among scientists that scientific meetings which bring together investigators from different fields of science are a necessity. But, with some distinguished exceptions, such meetings have been difficult to establish thus far.

2) Imposed restrictions of free communication: Although government support has been a major source of recent scientific growth, it has been accompanied by influences which are in some respects inimical to the basic needs of science. Complete freedom of communication, regardless of national boundaries, is an essential aspect of science; nevertheless, along with government support American science has been burdened with practices that restrict the free flow of information. The interchange of scientific information is sometimes restricted unduly by the overclassification of data that affect national security. It must be acknowledged that at certain times, and with certain types of data, restriction of exchange of information is necessary, so long as scientific progress continues to have military activity as one of its chief values. The immediate problem is to limit such restrictions to a minimal area. The ultimate problem is to free society as a whole and thereby science itself from the tyranny of war.

Not all artificially imposed restrictions on communication result from government requirements. There is an understandable tendency on the part of industry to protect its investment in research by restricting distribution of its results. As a greater share of research is taken on by industry, especially in those areas where expensive, complex operations are involved, this problem will become of greater significance. It is ironical to note that a recent Conference on the Practical Utilization of Recorded Knowledge—Present and Future (at Western Reserve University, January 1956), which devoted a good deal of attention to the problem of improved dissemination of knowledge, found it necessary to hold part of its deliberations behind closed doors and to refrain from publicizing the full record of these "confidential" sessions [(*Am. Scientist* (April 1956)].

Unrestricted communication is but one facet of the free intellectual environment that is as important to scientific creativity as it is to all other fields of human endeavor. If society is to benefit broadly and effectively from the efforts of modern science, and if science in turn is to be enriched by contributions from other fields, the social order must provide the greatest possible intellectual, social, and personal freedom for scientist and nonscientist alike at every level of the social structure.

Major Social Issues of Scientific Origin: Signs of Trouble

How well have we solved those social issues which are most closely related to scientific or technologic knowledge? Most of our successes are self-evident. Scientific knowledge is being applied to the development of a new industrial system capable of greatly increasing, in both quantity and quality, the total wealth of man. We are creating a remarkable establishment for medical and related research, which has given us mastery of many human ills and has prolonged the span of life. Nevertheless, scientific problems which influence social processes have become an arena of serious difficulties. In some situations our enhanced ability to control nature has gone awry and threatens serious trouble. Some examples follow.

Radiation dangers. It is hardly necessary to point out at this time that the difficulties created by the dispersion of radioactive materials from nuclear weapons have caused considerable concern in this country and throughout the world. Regardless of one's attitude toward the necessity of setting off nuclear explosions for testing purposes, there is considerable evidence that this aspect of human control over nature is a potential danger to life. The recent controversy over the immediate significance of this problem shows that we have not yet developed methods for the orderly determination of the facts, in an area in which such facts may influence the health of the whole population of the earth.

Food additives. The enormous growth of industry based on organic synthesis, coupled with the already mentioned tendency toward rapid exploitation of sci-

Resolution adopted by the Council of the American Association for the Advancement of Science at its 1956 meeting in New York

WHEREAS one of the purposes of the AAAS is "to improve the effectiveness of science in the promotion of human welfare, and to increase public understanding and appreciation of the importance and promise of the methods of science in human progress," and

WHEREAS the present rapid advance of science is accompanied by social problems of unprecedented magnitude that affect human welfare;

THEREFORE BE IT RESOLVED that in recognition of the responsibility of scientists to participate in deliberations regarding the use made of new scientific knowledge, the Council of the AAAS authorizes the president to continue the work of this committee by appointing an enlarged group for the purpose of defining the problems, assembling the relevant facts, and suggesting a practical program, to be submitted to the AAAS board of directors, to implement the objectives of the AAAS in this regard.

entific knowledge, has resulted in a great increase in the number of man-made compounds now used in foods or otherwise ingested or absorbed by human beings. The period of use of many of these substances has been rather short, and possible undesirable long-range biological effects have not yet had time to appear. Laboratory methods for studying delayed biological effects such as carcinogenicity are unfortunately difficult to manage and equivocal in interpretation. Consequently, the establishment of certification procedures which might assure the public that a given additive is harmless is a difficult matter which has been the subject of considerable discussion and controversy. Nevertheless, additives are in use, and the problem of making a reasonable determination of their safety must be faced.

A parallel situation exists in connection with the health hazards that arise from the dissemination of fumes, smogs, and dusts by industrial plants and from automotive and other combustion processes. The harmful biological effects of these agents usually appear a long time after the commercial usefulness of the process is established and large-scale operations are in effect. By then remedial procedures are very difficult to carry out.

In these cases the use of substances resulting from scientific advance has already outstripped the base provided by our scientific knowledge. Information on the biological effects of a new substance is acquired at a very much slower pace than the rate at which new substances are made or put into use. It is probably inevitable that biological research will move more slowly than either chemistry or physics, but it should be expected, therefore, that we would put correspondingly more effort into research on biological phenomena. The opposite is the case. Less than about 10 percent of our total research expenditure goes into biology and medicine.

Natural resources. The natural resources contained in the crust of the earth comprise the major source of our wealth, and it is a matter of concern that they be properly used. The natural laws which regulate the character and behavior of these resources lie within the domain of the various sciences. However, social decisions actually control what is done with our resources. It has been pointed out by Paul B. Sears that these decisions are rarely in the hands of scientists. Under these circumstances large-scale changes in our natural resources have occurred without proper consideration for the consequences which might be expected from a knowledge of natural laws.

An illuminating example cited by Sears is the recent flood disaster in New England. He points out that the widespread damage caused by these floods was a direct consequence of the unplanned crowding of housing areas into the river flood-plains. This was a failure to recognize and act upon physical events easily foreseeable from a relatively simple knowledge of the landscape. The declining water-table caused by irrigation practices illustrates a similar disregard for natural laws. In these and more complex instances, the harmful outcomes of the given practice can be predicted by appropriate technical analysis.

These examples show that social factors condition the use to which scientific knowledge is put. Perhaps the most striking example of this phenomenon is modern warfare, which represents a social decision to use the power of scientific knowledge for purposes of destruction and death.

Some Conclusions

The present state of science and its relation to the social structure of which it is a part are characterized by the following general features.

1) We are witnessing an unprecedented growth in the scale and intensity of scientific work. Research has placed in human hands the power to influence the life of every person in every part of the earth.

2) This growth has been stimulated by an intense demand for the practical products of research, especially for military and industrial use. Agencies which use the products of research are willing to provide financial support and other forms of encouragement for science but show a natural tendency to favor those fields and aspects of science which most nearly relate to their needs.

3) The public interest in, and understanding of, science is not commensurate with the importance that science has attained in our social structure. It cannot be said that society provides good conditions for the proper growth of science. The effort to explain the nature of science to the public is slight compared with the public attention now given to other less consequential areas of human activity. Interest in science as a career is so restricted that a serious and worsening personnel situation has arisen.

4) For reasons such as those just cited, science is experiencing a period of rapid but rather unbalanced growth. Basic research, which is the ultimate source of the practical results so much in demand, is poorly supported and, in the view of some observers, lacks vigor and quality. Areas more remotely connected with industrial and military applications, such as biology and the social sciences, are also not being adequately supported. The present period of rapid, unplanned growth in research activities is precipitating critical difficulties in connection with the dissemination and analysis of scientific information.

5) The growth of science and the great enhancement of the degree of control which we now exert over nature have given rise to new social practices, of great scope and influence, which make use of new scientific knowledge. While this advance of science has greatly improved the condition of human life, it has also generated new hazards of unprecedented magnitude. These include the dangers to life from widely disseminated radiation, the burden of man-made chemicals, fumes, and smogs of unknown biological effect which we now absorb, large-scale deterioration of our natural resources, and the potential of totally destructive war. The determination that scientific knowledge is to be used for human good or for purposes of destruction is in the control of social agencies. For such decisions, these agencies and ultimately the people themselves must be aware of the facts and the probable consequences of action. Here scientists can play a decisive role: they can bring the facts and their estimates of the result of proposed actions before the people.

Need for Action: the Role of the Organizations of Science

This appears to be a critical time for review of the general state of science and its relation to society. We are now in the midst of a new and unprecedented scientific revolution which promises to bring about profound changes in the condition of human life. The forces and processes now coming under human control are beginning to match in size and intensity those of nature itself, and our total environment is now subject to human influence. In this situation it becomes imperative to determine that these new powers shall be used for the maximum human good, for, if the benefits to be derived from them are great, the possibility of harm is correspondingly serious.

As scientists we are particularly concerned with determining how we should meet this situation, both as individuals and through our organizations. In marked contrast to other associations, scientific societies seldom consider the social and economic position of their group. Action taken on social problems with a scientific or technologic base are sporadic and usually forced. Yet the democratic system is operated to a considerable extent under stimulus from groups, each representing the views and interests of its members.

Business and labor are not backward in presenting their opinions on social questions that affect them. They make sure that in the final decision their views have been considered. There are many who think that the viewpoint of scientists should also be stated publicly. In fact, if others express their opinions and scientists do not, a distorted picture will be presented, a picture in which the importance of science will be lacking and the democratic process will become to that extent unrepresentative.

The need for action is serious and immediate. Consider, for example, the situation related to the biological hazards of radiation. It is now 6 months since the radiation committees of the National Academy of Sciences issued a report that called for a series of immediate actions including, among others: (i) the institution of a national system of radiation exposure record-keeping of all individuals; (ii) vigorous action to reduce medical exposure to x-rays; (iii) establishment of a national agency to regulate disposal of radioactive wastes; (iv) establishment of an international program of control and study of radioactive pollution of the oceans; (v) considerable relaxation of secrecy about dissemination of radioactivity. In addition, the committees pointed out that "The development of atomic energy is a matter for careful integrated planning. A large part of the material that is needed to make intelligent plans is not yet at hand. There is not much time left to acquire it."

There is no evidence that these urgent pleas for action have yet met with any significant response. Clearly, this is a matter that requires the persistent attention of all scientists. It exemplifies the pressing need that scientists concern themselves with social action. In this situation, the AAAS carries a special responsibility. As one of our past presidents, Warren Weaver, has said: "If the AAAS is to be a vigorous force for the betterment of science, it cannot continue in the face of crucial situations with closed eyes and a dumb mouth." This responsibility has already been recognized. What is needed now is a way to meet it.

Humble Oil Company Radiocarbon Dates I

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The radiocarbon ages given in Table 1 were determined by the geochemical research group of the Production Research Division, Humble Oil and Refining Company. The method used, which has been described in a previous publication (*1*), was proportional counting of carbon dioxide that had been prepared from the sample under assay. The counter was filled to an absolute pressure of 5 atmospheres of carbon dioxide in all cases.

The ages are based on a half-life of radiocarbon of 5568 ± 30 years (*2*) and on an assay of contemporary carbon, whether in the form of organic carbon or of calcium carbonate, of 20.27 ± 0.15 count per minute for the particular counter used. This value was obtained by the extrapolation to zero age of assays of tree rings greater than 50 years in age. Background counting rates were in the neighborhood of 5 counts per minute, with a statistical uncertainty of ± 0.07 count per minute.

The samples described in the table were obtained from sites that have been studied primarily for obtaining archeological information. However, since the stratigraphic relationships of a number of the sites in the lower Mississippi Valley have been developed, the radiocarbon ages of the archeological samples contribute not only to the archeological history, but also to the development of an absolute chronology of sedimentary events in the region.

The authors are on the staff of the Production Research Division, Humble Oil and Refining Company, Houston, Tex.

References

1. H. R. Brannon, M. S. Taggert, Jr., M. Williams, *Rev. Sci. Instr.* 26, 269 (1955).
2. W. F. Libby, *Radiocarbon Dating* (Univ. of Chicago Press, Chicago, Ill., ed. 2, 1955).

Table 1. Radiocarbon dates obtained on archeological samples.
All ages are given in radiocarbon years before the present.

Description	Sample No.	Age (yr)
Manny site, Issaquena County, Miss. Sample from a deposit that consisted largely of carbonized fragments of cane (*Arundinaria macrosperma*, identified by E. S. Barghoorn, curator of paleobotany, Harvard University). From cut C, − 23 to − 43 cm, uppermost stratum. Should date the Coles Creek phase. Collected 20 April 1954. Submitted by Phillip Phillips and Robert E. Greengo, Peabody Museum, Harvard University.	O-12 O-23 O-27	1130 ± 100 980 ± 100 1080 ± 100 Average 1050 ± 100
Thornton site, Issaquena County, Miss. Sample from a deposit of carbonized cane and wood about 22 cm in diameter. From cut C, − 140 to − 158 cm. Should date the Issaquena phase. This is a regional phase in the lower Yazoo Basin that probably falls within the Troyville period as defined by James A. Ford, American Museum of Natural History, and others. Collected 2 March 1954. Submitted by Phillip Phillips and Robert E. Greengo.	O-24	1410 ± 100
Thornton site, Issaquena County, Miss. Sample from a deposit of carbonized materials, about 22 cm in diameter, including a greater proportion of wood than that tabulated under sample O-24, but otherwise similar. From cut D, − 128 to − 141 cm. Physical stratification good. Should date the Issaquena phase. Collected 3 March 1954. Submitted by Phillip Phillips and Robert E. Greengo.	O-25	1420 ± 100

Description	Sample No.	Age (yr)
Thornton site, Issaquena County, Miss. Sample from a deposit of carbonized materials, mostly carbonized wood, 19 by 26 cm in cut E, −130 to −140 cm. Apparently from a large pit intrusive to this deposit from uppermost strata. The associated material is either Coles Creek phase or mixture of Coles Creek and Issaquena phases. Collected 16 March 1954. Submitted by Phillip Phillips and Robert E. Greengo.	O-26	1180 ± 100
Manny site, Issaquena County, Miss. Sample from a deposit of carbonized cane 28 cm in diameter from cut W, −140 to −160 cm. Deposit was found in dark, brown-stained clayey silt (sterile natural levee) some 15 cm beneath the lower midden stratum, from which this deposit appears to be intrusive. Should date the earliest occupation (Issaquena) in the excavation area. Collected 15 April 1955. Submitted by Phillip Phillips and Robert E. Greengo.	O-143	1260 ± 100
Manny site, Issaquena County, Miss. Sample from a deposit of carbonized cane 45 cm in diameter, cut U, −128 to −146 cm (sample from bottom 6 cm), at the bottom of the lower midden stratum. Should date the Issaquena phase. Collected 29 April 1955. Submitted by Phillip Phillips and Robert E. Greengo.	O-145	1100 ± 100
Manny site, Issaquena County, Miss. Sample from a carbonized cane deposit in cut AA (in top center of mound A, a rectangular mound 4 m high). From −172 cm. Deposit is in a matrix of olive-brown, silty clay (mound loading). This cane deposit is most likely related to an occupational level or incipient soil profile demarked by a band of charcoal flecks and ash some 5 to 10 cm thick at −150 cm. The few sherds recovered in this cut are mostly Issaquena, but they may have been scraped up from an earlier midden. Collected 24 April 1955. Submitted by Phillip Phillips and Robert E. Greengo.	O-146	1170 ± 100
Manny site, Issaquena County, Miss. Sample of carbonized material, mostly wood from cut Y, at −40 cm. Sample found within the much-disturbed upper occupation strata. The sherd count indicates Coles Creek phase. Collected 24 February 1955. Submitted by Phillip Phillips and Robert E. Greengo.	O-147	700 ± 100
Mabin site, Yazoo County, Miss. Sample from a deposit of carbonized cane 24 cm in diameter, cut EC, from −50 to −56 cm in midden 67 cm deep. The sherds tentatively suggest the Issaquena phase. Collected 20 April 1955. Submitted by Phillip Phillips and Robert E. Greengo.	O-148	1300 ± 100
Manny site, Issaquena County, Miss. Sample from a deposit of carbonized cane and other materials in cut Z, at −32 cm. Little disturbance indicated. Should date the Coles Creek phase. Collected 23 February 1955. Submitted by Phillip Phillips and Robert E. Greengo.	O-150	800 ± 100
Liberty Bayou site, St. Tammany Parish, La. Slidell quadrangle, SW¼, NE¼, sec. 14, T9S, R13E. *Rangia* shells, (Tchefuncte period) from 24 to 30 in. below the top of the midden. Submitted by W. G. McIntire, Louisiana State University.	O-28	1900 ± 110
St. Tammany − 1 site, (original Tchefuncte site) St. Tammany Parish, La. Covington quadrangle, lat. 30°19′40″N, long. 90°01′30″W. Deer antlers (Tchefuncte period) from 30 to 60 in. below the surface. Organic and inorganic carbon were submitted separately to radiocarbon assay. The age from organic portion (sample O-30) is considered to be more valid because the inorganic carbonate (sample O-42) apparently contained intrusive material of younger age. Submitted by W. G. McIntire.	O-30 O-42	2200 ± 110 800 ± 100
Bayou Grand Caillou site, Terrebonne Parish, La. Lat. 29°22′38″N, long. 90° 43′05″W. *Rangia* shells (Plaquemines period) from 1 ft above sea level. Submitted by W. G. McIntire.	O-39 O-44 Average	200 ± 100 300 ± 100 250 ± 100
Magnolia Mound site, St. Bernard Parish, La. Shell Beach quadrangle, lat. 29°53′18″N, long. 89°32′00″W. *Rangia* shells (Marksville period) from 24 to 36 in. below sea level. Submitted by W. G. McIntire.	O-49	1830 ± 100
River aux Chênes site, Plaquemines Parish, La. Pointe à la Hache quadrangle, lat. 29°37′58″N, long. 89°47′13″W. *Rangia* shells (Troyville period) from 2.5 ft below sea level. Submitted by W. G. McIntire.	O-71	1930 ± 110
St. Tammany − 12 site, St. Tammany Parish, La. Slidell quadrangle, lat. 30° 18′40″N, long. 89°51′40″W. *Rangia* shells (Tchefuncte period) from 2 to 3 ft below the surface of midden. Submitted by W. G. McIntire.	O-76	1430 ± 100
River aux Chênes site, Plaquemines Parish, La. Pointe à la Hache quadrangle, lat. 29°37′58″N, long. 89°47′13″W. Bones from the surface of shell midden (Troyville period). Only the organic portion was used in radiocarbon assay. Submitted by W. G. McIntire.	O-77	860 ± 100
Bayou Petre site, St. Bernard Parish, La. Lake Eloi quadrangle, lat. 29°49′48″ N, long. 89°25′54″W. Bones from the surface of shell midden (Plaquemines period). Only the organic portion was used in radiocarbon assay. Submitted by W. G. McIntire.	O-78	360 ± 100
Magnolia mound site, St. Bernard Parish, La. Shell Beach quadrangle, lat. 29°53′18″N, long. 89°32′00″W. Bones (Marksville period, but possibly contaminated) from 1 ft below sea level. Only the organic portion was used in radiocarbon assay. Submitted by W. G. McIntire.	O-80	900 ± 100
Metairie Ridge area, Jefferson Parish, La. Spanish Fort quadrangle, lat. 30° 01′00″N, long. 90°08′45″W. Charcoal sample (Troyville period) from sea level in shell mound. Submitted by W. G. McIntire.	O-102	1440 ±100
Miller (Belle River) site, St. Mary Parish, La. Pierre Pass area, lat. 29°54′32″N, long. 91°13′00″W. Charcoal sample (Troyville horizon) from 1 ft above sea level. Submitted by W. G. McIntire.	O-104	990 ± 100
Larose area, Lafourche Parish, La. Cut off quadrangle, lat. 29°36′20″N, long. 90°22′25″W. *Rangia* shells (Coles Creek period) from 3 ft above sea level, from earth and shell mound. Submitted by W. G. McIntire.	O-110	1550 ± 100

Description	Sample No.	Age (yr)
Bayou Grand Caillou site, Terrebonne Parish, La. Lat. 29°22′38″N, long. 90° 43′05″W. Charcoal sample (Plaquemines period) from 3.5 ft above sea level. Submitted by W. G. McIntire.	O-113	260 ± 100
Magnolia Mound site, St. Bernard Parish, La. Shell Beach quadrangle, lat. 29°53′18″N, long. 89°32′00″W. Bone sample (Marksville period, but possibly contaminated with younger material), from sea level. Only the organic portion was used in radiocarbon assay. Submitted by W. G. McIntire.	O-123	1050 ± 100
Little Chenier site, Cameron Parish, La. Grand Chenier quadrangle, lat. 29° 49′30″N, long. 92°54′50″W. Bone sample (Coles Creek period) from 6 ft below the surface of an earthen mound at the contact with chenier matrix. Only the organic portion was used in radiocarbon assay. Tchefuncte period pottery was found in the mound, so that the Coles Creek sample does not date the ridge, but rather the level from which the sample was obtained. Submitted by W. G. McIntire.	O-125	700 ± 100
Blackwater Locality No. 1, Roosevelt County, N.M. Organic portion of charred bones from Sanders gravel pit, Charles Baxter ranch, about 7 mi north of Portales. The stratigraphic position of the sample is post-Pleistocene, and the culture is Archaic. Collected by Oscar R. Shay, Portales, N.M., in August 1954. Submitted by E. H. Sellards, Texas Memorial Museum, Austin.	O-157	4950 ± 130
Blackwater Locality No. 1, Roosevelt County, N.M. Organic portion of uncharred bones from Sanders gravel pit, Charles Baxter ranch, about 7 mi north of Portales. The stratigraphic position of the sample is that of the Portales culture complex. Collected by E. H. Sellards and Oscar R. Shay, November 1955. Submitted by E. H. Sellards.	O-169	6300 ± 150
Blackwater Locality No. 1, Roosevelt County, N.M. Organic portion of charred bones from Sanders gravel pit, Charles Baxter ranch, about 7 mi north of Portales. The stratigraphic position is that of the Portales culture complex, and the sample is identical with sample O-169 except that the bones were charred when found. This sample not only affords a check on the age of the complex, but also permits a comparison of the ages obtained by the use of charred and uncharred bones, respectively. Collected by E. H. Sellards and Oscar R. Shay, November 1955. Submitted by E. H. Sellards.	O-170	6230 ± 150
Plainview Locality, Hale County, Tex. Organic portion of bones from city caliche pit in the southwest part of the city of Plainview. The sample is from the Plainview cultural level. Collected by E. H. Sellards and Otto Schoen, Texas Memorial Museum, Austin, in June 1955. Submitted by E. H. Sellards.	O-171	7100 ± 160
Jaketown Site, Humphreys County, Miss. Shells from Poverty Point horizon, 5.0 to 5.5 ft below surface, near Belzoni. Sample submitted by J. A. Ford, American Museum of Natural History, New York.	O-41	2560 ± 110
Jaketown Site, Humphreys County, Miss. Bone samples from Poverty Point horizon, 10.5 to 12.5 ft below surface, at Jaketown archeological site, near Belzoni. Because of the small size of sample, it was necessary to utilize both the organic and the inorganic constituents of the bones in the radiocarbon assay. Incorporation of the inorganic constituents throws some doubt on the validity of the age. Submitted by J. A. Ford.	O-46	2150 ± 110
Jonesville Site, Catahoula Parish, La. Poorly preserved bones from Jonesville archeological site (formerly termed Troyville Site). Because of the small size of sample, it was necessary to use both organic and inorganic constituents of the bones in the radiocarbon assay. Incorporation of the inorganic constituents throws some doubt on the validity of the age. Submitted by J. A. Ford.	O-48	900 ± 100
Poverty Point Site, West Carroll Parish, La. Plant remains and charcoal sample from basal mound B, Poverty Point archeological site. Sample was extremely poor and consisted primarily of plant remains. Submitted by J. A. Ford.	O-66	3150 ± 120
Lewisville Site, Denton County, Tex. Charcoal sample from an archeological site near Lewisville. The site, discovered and excavated by W. W. Crook, Jr., R. K. Harris, and others of the Dallas Archeological Society, is in an alluvial terrace of the Trinity River (the high, unaltered original Union Terminal-Carrollton Terrace). It was exposed by erosion of the surface of a large borrow pit from which earth was removed several years ago for construction of the Lewisville Dam. Sample from a hearth (hearth No. 1) approximately 8 ft by 10 ft underlain by a heavy red-burned zone approximately 15 in. deep. Stratigraphically, the hearth lies in the basal portion of the locally designated Upper Shuler formation. Prior to excavation of the borrow pit, the hearth lay nearly 20 ft below the terrace surface, this surface in turn being approximately 70 ft above the normal level of the present Trinity River. Associated with the charcoal in this particular hearth were bones of bison, deer, wolf, prairie dog, rabbit, and birds; freshwater clam and snail shells; and charred hackberry seeds. In addition, elsewhere and adjacent in the site, occur bones of elephant, camel, horse, antelope, coyote, glyptodon, and of many small mammals. Also found in the hearth at a location some 20 in. away from the location of the charcoal sample was a Clovis projectile point. The charcoal content of the sample was small, and the charcoal itself was predominately in the form of very small particles. Sample collected in March 1956, by W. W. Crook, Jr., R. K. Harris, and other members of the Dallas Archeological Society. Submitted by W. W. Crook, Jr., Dallas, Tex.	O-235	> 37,000
Lewisville Site, Denton County, Tex. Charcoal from hearth No. 8 (a general description of the site is given in the description of sample O-235). Hearth No. 8 lies approximately 300 ft northeast of hearth No. 1 and on the same stratigraphic level; a continuous area of hearths and faunal remains connect the two.	O-248	> 37,000

Description	Sample No.	Age (yr)
Hearth No. 8 is approximately 30 in. in diameter and 6 in. deep. It contained the charred remains of three small logs from which sample was taken. Associated with charcoal in hearth No. 8 were charred terrapin carapace fragments, small rodent bones, snail shells, and charred hackberry seeds. This sample has been classified by E. S. Barghoorn, curator of paleobotany, Harvard University, as wood charcoal. There was a sufficient number of large fragments to permit hand-picking of the sample for radiocarbon assay. Collected by W. W. Crook, Jr., R. K. Harris, and other members of the Dallas Archeological Society, May 1956. Submitted by W. W. Crook, Jr.		

News of Science

New Type Nuclear Reaction

The observation of a new kind of nuclear reaction that yields energy and is akin to thermonuclear reactions was reported recently to the American Physical Society by scientists in the University of California Radiation Laboratory. The scientists who participated in the research are Luis W. Alvarez, Hugh Bradner, Frank S. Crawford, Jr., John A. Crawford, Paul Falk-Vairant, Myron L. Good, J. Don Gow, Arthur H. Rosenfeld, Frank Solmitz, M. Lynn Stevenson, Harold K. Ticho, and Robert D. Tripp.

The new phenomenon is described as a "catalyzed nuclear reaction." This adds to those reactions already known to science a new and third way of making a nuclear reaction take place. The older ways are either to induce thermonuclear reactions, in which two light nuclei fuse into a heavier one when the temperature is raised to roughly 1 million degrees, or else to bombard nuclei with other nuclear particles from accelerators like cyclotrons or nuclear reactors.

In order to make a nuclear reaction take place, two nuclei must touch. The new discovery is a way of pulling two nuclei together so that a proton and a nucleus of heavy hydrogen (a deuteron) can combine to form helium-3 with the release of 5.4 million volts of energy. This pulling together takes place in a mesic molecule.

In a normal molecule the nuclei of the component atoms are pulled together weakly by electrons. But the electron can be replaced by a much heavier particle, the negative mu meson. Because the mu is 210 times heavier than an electron, it circles the nucleus at only 1/210th the distance of an electron, and thus binds the two nuclei correspondingly closer. The nuclei then have a good chance of touching, and the nuclear reaction can take place.

The reaction is termed a catalyzed reaction because the mu meson is not consumed by the reaction but may be ejected from the molecule by the energy released. The mu is then free to catalyze more reactions, in chain fashion.

The Berkeley group emphasized that at the present time the energy-producing chain of catalyzed reactions cannot continue long enough to generate commercially useful amounts of power, because mu mesons decay into other particles after two-millionths of a second. Unfortunately, from the point of view of thermonuclear power mu mesons can be made only in high-energy nuclear collisions of particles accelerated by cyclotrons and other expensive machines. However, the scientists described as "interesting" the possibilities if a much longer lived particle, with properties similar to that of the mu meson, is ever found. The Russian physicist Alikhanian has reported evidence for such a particle.

The observations were made in studies of photographs taken of tracks in the 10-inch hydrogen bubble chamber which is being used with the Berkeley bevatron, at present the most powerful such machine in the world (a larger one is about to go into operation in the Soviet Union).

The bubble chamber is filled with liquid hydrogen, which boils and forms tiny bubbles along the track of any charged particle that goes through it. Photographs can thus be made of the trail of a particle in much the same way that one can record the passage of an otherwise invisible jet plane by photographing its vapor trail. The bubble chamber was invented at the University of Michigan and has been highly developed at Berkeley. It is tending to replace an older but similar tool, the cloud chamber. This is because a greater number of interesting nuclear collisions and events occur in a given volume of liquid hydrogen than in the more rarified gas of a cloud chamber.

Scientists expected that all mu mesons that came to rest in hydrogen would simply decay. Consequently there was excitement in the Berkeley group when it was noticed that occasionally a particle that looked like a mu came to rest but, instead of decaying, flung out another particle that also looked like a mu, went a short distance, came to rest, and decayed. In some of the photographs there was a gap between the two mu-like tracks. At first there was speculation about a new particle, a "super-mu" which decayed into an ordinary mu.

The pictures are now understood as follows. When the negative mu comes to rest it becomes attached to a proton, forming a mu-mesic atom that is similar to an ordinary electronic atom but scaled down 200-fold in size. In natural hydrogen, one atomic nucleus in 5000 has a neutron stuck to its proton and is called a deuteron. It can be shown that a mu meson prefers to form an atom with a heavy particle at its center; so the mu will form an atom selectively with a deuteron, even though the protons are much more abundant. Any mu-mesic atom will eventually attach itself to another atom to form a molecule.

The gaps are explained as a drift of the tiny neutral mu mesic deutron atom as it dashes away from the proton from which it stole its mu meson. Any complete atom, regardless of its size, is a neutral system, and does not make a track. Being neutral, the mesic atom makes no track.

The result of all these processes is that shortly after a mu comes to rest in hydrogen it finds itself holding a deuteron and proton together in the form of a tiny molecule. The deuteron and the proton are bound so closely that soon

they fuse to form helium-3. The mass of helium-3 is less than the combined mass of a proton and a deuteron, and the difference—5.4 million electron volts—is available as energy. This energy of fusion is the same energy that is released by the sun or during thermonuclear reactions.

Another way of looking at the reaction was described as follows. The mu meson holds the deuteron and proton together as if in a tiny box until they fuse. Thus fusion does not take place in ordinary molecules because the volume of the box is 10 million times larger.

In order to test their hypothesis, the physicists added artificially concentrated deuterium to the naturally occurring deuterium already in the bubble chamber. As was expected, there was an increase in the fraction of photographs in which there was an ejected mu or a gap at the end of a mu. Two pictures out of 10,000 showed a chain reaction two links long—where a single mu catalyzed two nuclear reactions before decaying.

After the experiments were completed, a colleague pointed out that in the 1954 *Proceedings of the Academy of Sciences of the U.S.S.R.* a theoretical physicist, Ya. B. Zel'dovitch, had already predicted a similar, though somewhat simpler, reaction.

The term *catalyzed nuclear reaction* was selected because of the comparison with what happens in chemistry, where a catalyst is used to speed up a reaction but is not itself used up in the reaction. A catalyzed nuclear reaction is similar to a thermonuclear reaction in that the same nuclear fusion reactions are common to both, but the conditions of the surroundings are quite different. Thermonuclear reactions take place only at extremely high temperature—in stars or hydrogen bombs—between nuclei propelled together by the great heat; a mu meson can pull nuclei together and catalyze a nuclear reaction at any temperature.

One of the great problems of controlled thermonuclear reactions lies in the need to maintain enormous heat in a confined system. Known materials melt at such temperatures, and investigations are under way to make "pinch containers" in which the hot materials do not touch the sides of the container. The difficulty is that the present containers leak.

National Health Survey

The U.S. Public Health Service has announced that a pilot test study under the new National Health Survey program will begin on 28 Jan. in Charlotte, N.C. The National Health Survey is being undertaken under legislation enacted by Congress last summer. The new law authorizes the Surgeon General of the Public Health Service to make continuing annual surveys and special studies of this country's population to determine the extent of illness and disability and gather related information. The last previous such federal survey was conducted 20 years ago.

The initial action in Charlotte will test a number of aspects of a questionnaire that is being developed for national use at a later date. Interviewing will be conducted by the Bureau of the Census, which is to perform this advance test and other field work on the survey. Data to be collected will include statistics on the number, age, sex, and occupation of persons suffering from diseases, injuries, or handicapping conditions; medical care received; the length of time that these people have been prevented from carrying on their usual occupations or activities; and the economic and other impacts of such conditions.

Sesquicentennial of Geodetic Survey

The Coast and Geodetic Survey plans a series of public events this year to celebrate its 150th anniversary. The survey was established in February 1807 under President Jefferson as the Government's first technical bureau. It has grown to the point where it now conducts official basic surveys of land areas and coastal waters of the United States and its possessions.

Its common services include tide tables for navigators, bathers, and fishermen; aeronautical charts for fliers; nautical charts for mariners; and starting points for surveyors. Admiral H. Arnold Karo is the director.

The anniversary program will be marked by the issuance of a special postage stamp. Plans are underway for sesquicentennial dinners, open house celebrations at survey headquarters, field offices and aboard ships, and for meetings of scientific and professional societies.

Teller on the Use of Nuclear Weapons

Edward Teller, nuclear physicist, discussed the moral issue involved in the use of nuclear weapons in a recent issue of the Air Force Association's monthly magazine *Air Force*. Teller stated that it would be "a considerable mistake for us to accept the idea that nuclear weapons are, on a moral plane, of a different nature from conventional weapons."

He noted that the U.S.S.R. had been exploiting the fact that the only use of atomic weapons in war so far had been against the civilian populations of Hiroshima and Nagasaki, Japan. He commented that "Russian propaganda has exploited this theme and has made it difficult, perhaps for the time being impossible, to make use of nuclear weapons, even in situations where such use would be logical and justified."

Rabies Treatment

The effectiveness of serum plus vaccine in preventing rabies in a group of persons who were severely bitten by a rabid wolf in Iran last year, and in similar less extensive experiences, was accepted as clear demonstration of the usefulness of the method by the Third World Health Organization Expert Committee on Rabies which recently met at the Pasteur Institute in Paris.

The meeting had historic interest inasmuch as it was at the institute that Pasteur introduced rabies vaccination for human beings more than 70 years ago.

This important step forward resulted from international collaboration, coordinated by WHO. The committee members, whose laboratories are situated in India, Iran, Israel, Spain, France, and the United States, have been working together on problems of rabies control since 1950.

The new approach involves providing basic protection by giving very small doses of chicken embryo vaccine, or a few doses of ordinary nervous tissue vaccine, followed by a single booster dose of vaccine rather than by the long schedule (14 to 21 days) of inoculations now performed.

Recently developed vaccines prepared from chicken embryos were found to confer long-term protection on dogs by only a single inoculation and were demonstrated to be useful also for cattle. It was stressed by the committeee that it is not only necessary to vaccinate dogs but also to control stray animals.

Rabies in wildlife, particularly in foxes, jackals, and wolves, is a problem in many countries. It also exists in insectivorous bats in areas of North America, and it has long been established that rabies is transmitted to men and animals in Latin America by blood-sucking bats. The finding of rabies in insectivorous bats in Yugoslavia indicates that this problem is not confined to the Western Hemisphere. Wild animal reservoirs present special difficulties, and it was agreed that extraordinary measures must be evolved to combat them.

The committee also suggested the establishment and use of an international standard reference serum and vaccine for countries throughout the world, so that procedures will be more uniform, and the potency of antirabic substances will be assured at time of use.

It also outlined forms for case reporting and case histories, to improve statis-

tics and the evaluation of procedures used in prophylaxis. Other recommendations include a simple guide for physicians in treating persons bitten and for dealing with the problem faced by governments importing cats and dogs from countries where rabies is known to exist.

In the Americas, the countries are receiving assistance with their rabies problems from the Pan-American Sanitary Bureau, Regional Office of WHO for the Americas.

Extensive studies in rabies from bats have been made in Mexico and in the United States-Mexico border area, with the assistance of PASB. Assistance was provided to Mexico in the establishment of equipment and techniques for the production of chick-embryo type of vaccines, including one for the immunization of cattle.

In 1957, a WHO Regional Rabies Training Course is planned which will be held in Caracas, Venezuela. This will be attended by rabies control personnel from each country in the Americas. In addition, PASB/WHO will provide a special adviser to the countries to assist in improving rabies diagnosis, the promotion of antirabies programs, and the production of rabies vaccines and antirabies serum.

Permanent Magnet

A major advance in magnet technology, one that is expected to lead to the commercial development of an unusually versatile and powerful permanent magnet, has been announced by the General Electric Instrument Dept., West Lynn, Mass. The company reports that with a new fine-particle ferromagnetic material it has already produced experimental permanent magnets equal to the strongest commercial magnets now available, and there is every expectation that a magnet can be made that is 10 times stronger.

The new magnet is made from elongated single-domain iron particles of high coercive force with properties that confirm the existence of the shape-anisotropy effect. The submicroscopic particles can be imbedded in plastics, metals, rubber, or glass. The resulting magnets have properties not heretofore attainable, for they can be easily machined, drilled, tapped, and molded precisely into any desired shape, opening up new possibilities to the design engineer. The elimination of cobalt and nickel in the new process makes possible for the first time the application of magnets in nuclear reactors, which so far has been limited because of the potential radioactivity of cobalt.

Key members of the research team that developed the magnet are on the staff of the Measurements Laboratory of the company's Instrument Department at West Lynn, Mass. They are T. O. Paine, laboratory manager, F. E. Luborsky, and L. I. Mendelsohn. Paine and his associates were honored for their work at the recent Industrial Science Citation Dinner sponsored by the AAAS Industrial Science Section.

The permanent magnet is of fundamental importance to industry. Every year more than 50 million magnets are produced and used in the United States. A single bombing plane requires at least 200 magnets in its instrumentation, and a magnet is an essential part of radios and television sets.

Transplantation of Human Tumors

Because of the many requests for such instruction, a 3-day session on the techniques and problems associated with the heterologous transplantation of human tumors will be held 4–6 Mar. at the Sloan-Kettering Institute, New York. In addition to lectures and laboratory demonstrations, opportunities will be provided for participants to work with various transplantable human tumors, a variety of animal hosts, and chick eggs. Tissue cultures derived from the transplantable human neoplasms will be demonstrated also. The value of these tumors in various research programs will be discussed.

The session, for which there will be no charge, will be given by H. Toolan, D. Karnofsky, A. Moore, G. Woolley, and J. Harris. Inasmuch as attendance will be limited to 25 people, requests for participation should be sent as soon as possible to Dr. Helene W. Toolan, Sloan-Kettering Institute, 410 E. 68 St., New York, N.Y.

Spectrophotometric Data

M. J. Kamlet of the chemistry division, Naval Ordnance Laboratory, and H. E. Unguade of the Los Alamos Scientific Laboratory, Los Alamos, N.M., are preparing for publication a collection of all the spectrophotometric data in 60 journals for the period 1946–56. They are currently looking for additional contributors who might help in this project.

New Science Journal for the Public

A new weekly popular science journal, *The New Scientist*, began publication in London late last year. The journal is "published for all those men and women who are interested in scientific discovery and in its industrial, commercial and social consequences." The magazine carries, among other sections, editorials, lead articles, news, an American newsletter, overseas news, book reviews, letters to the editor, and a scientific crossword puzzle. It is published by Cromwell House, Fulwood Place, High Holborn, London, W.C.1. The annual subscription rate for the U.S.A. is $8.50.

Shutdown at AEC's Dana Plant

The U.S. Atomic Energy Commission has announced that operation of its heavy water plant near Dana, Ind., will be discontinued and the facility placed in a standby condition. Dana is one of the commission's two heavy water units. The other is at the Savannah River Plant in South Carolina. Forecasts of future heavy water requirements now indicate that only one of the heavy water production units will be needed during the next few years.

Shutdown at Dana will be accomplished over a period of 9 months, with first layoffs of the approximately 900 employees beginning in the early spring of 1957. A slow, orderly closure is planned to permit maximum recovery of the material in the plant vessels and to assure careful preservation of equipment. The plant is expected to be in full standby condition late in 1957.

Marriage Statistics

The U.S. Public Health Service has announced that an improved system of collecting marriage statistics will be adopted by the National Office of Vital Statistics in cooperation with 29 states and four territories. The system will record data on more than half the marriages that occur in the nation, making it easier to obtain facts about the formation of new families in the participating states. Such information is needed for community planning and many other purposes.

The participating states and territories have agreed to maintain central files of marriage records by securing reports from local officials. (In many states, at present, marriage records are available only in local communities; this makes it difficult for heirs and others to locate old marriage records if they do not know exactly where the marriage occurred.) The 29 states have also agreed to cooperate in making periodic tests of the completeness and accuracy of their marriage registrations. The states will use most of the items on a recommended Standard Record of Marriage.

Standard birth and death registration statistics have been collected for many years and are now nation-wide, providing data which are used by health and

welfare agencies, industries, and other groups. The need for comparable, reliable data on marriages has long been recognized. The new Marriage Registration Area, embracing the 29 states and 4 territories, although not yet nation-wide, will help to meet this need.

Victorian Studies at Indiana

Indiana University is sponsoring a new quarterly journal to be called *Victorian Studies*. It is expected to begin publication in the fall of 1957. It is to be an interdisciplinary journal dealing with the arts, humanities, and sciences as they relate to England approximately from 1830 to 1914. The editors welcome contributions which should be sent to: Victorian Studies, Indiana University, Bloomington, Ind.

Polio Decline

According to a report of the U.S. Public Health Service, there was a marked decline in the number of cases of poliomyelitis during the polio year beginning in April 1956 in comparison with the similar period in 1955. The total number of cases since April 1956 was 14,061 in contrast to 27,753 for the polio year in 1955.

Of the estimated 66 million in the group that have been eligible up till now (persons under 20 and pregnant women), only 40 million have received one, two, or three injections of the Salk vaccine.

A surplus of about 21 million shots of the vaccine is now available through the manufacturers, and a good deal more is in the hands of retailers and physicians. The USPHS recommends that the rest of the population receive inoculations now that the supply is adequate.

Beckman Acquires Watts

Beckman Instruments, Inc., has announced the acquisition of Watts Manufacturing Company, Inc., Ronceverte, W.Va., manufacturer of a new, continuous-action gas chromatograph. In addition, Watts makes temperature test stands for jet engine development and automatic flaw detectors for the textile industry.

Nuclear Technology Fellowships

Applications are now being accepted for participation in the program of special fellowships in nuclear energy technology recently announced by the U.S. Atomic Energy Commission. The program will be administered by the Oak Ridge Institute of Nuclear Studies, which now administers for the commission the special fellowships in radiological physics, the special fellowships in industrial hygiene, and the ORINS graduate fellowship program.

The fellowships are open to students with the bachelor's degree in engineering, chemistry, mathematics, or physics, who have completed a course in ordinary differential equations. Applicants must be United States citizens and be granted fellowship clearance by the commission. Before fellowship appointments become effective, the applicant must be accepted as a candidate for a master's degree by an institution offering the necessary program of study.

The commission is making a selection of programs of graduate study which meet the fellowship requirements. Institutions offering these programs will be listed with the application forms and applicants may choose their institutions from this list. The program of study will include the following courses: nuclear physics, nuclear reactor analysis, nuclear reactor technology, radiochemistry and reactor materials, and advanced mathematics.

Fellowships will be awarded for 1 year's study. The fellowship award carries a basic stipend of $1800, with an additional allowance of $350 for a spouse and $350 each for a maximum of two dependent children. The award also includes the payment of normal tuition, required fees, and a travel allowance of 6 cents per mile for the fellow (not dependents) from his place of residence (or application) to his university. Fellows are expected to devote all their time to study and research and may not engage in work for remuneration, or receive aid from another scholarship, fellowship, or similar grant during the term of this fellowship.

Applications may be obtained from the Fellowship Office, Oak Ridge Institute of Nuclear Studies, Post Office Box 117, Oak Ridge, Tenn. Completed forms, supporting letters of reference, and transcripts must reach ORINS *not later than 15 Feb.*

Scientists in the News

CLARENCE ZENER, formerly an associate director of the Westinghouse Research Laboratories and for the last year acting director, has been appointed director of the laboratories. Zener is author of the Zener theory of ferromagnetism, which explains why certain materials are strongly magnetic, and of the Zener effect, a theoretical explanation of the electric breakdown in semiconductors such as germanium and silicon.

WILLIAM P. JACOBS, associate professor in the biology department at Princeton University, is going to spend the spring and summer of 1957 at the Marine Station, Naples, Italy, where he will be studying the normal and experimental development of various siphonaceous algae. This research is being supported by the National Science Foundation under its senior postdoctoral fellowship program.

ROGER W. HOWELL, formerly professor of mental health at the University of North Carolina School of Public Health, has been appointed head of the Division of Preventive Psychiatry at the Lafayette Clinic, Michigan's neuropsychiatric center. He will teach and conduct research at the clinic and also at Wayne State University's College of Medicine.

FRANK GERBODE of Stanford Medical School has been unanimously elected an "Honorary Perpetual Student" of St. Bartholomew's Hospital Medical College, London, England. Gerbode served as an associate in surgery at St. Bartholomew's Hospital in 1949. He was recently chosen first vice president-elect of the American College of Surgeons, and is a past president of the San Francisco Heart Association.

JOHN P. FRAWLEY, formerly assistant chief in the chronic toxicity branch of the U.S. Food and Drug Administration, will fill the newly created post of toxicologist in the Hercules Powder Company's medical department.

W. F. CLAUSSEN, for the past 5 years a research chemist at the Corning Glass Works, Corning, N.Y., has been appointed a physical chemist in the metallurgy and ceramics research department of the General Electric Research Laboratory, Schenectady, N.Y.

URNER LIDDEL, research physicist with the National Institute of Arthritis and Metabolic Diseases, Bethesda, Md., has been named a program director in the Division of Scientific Personnel and Education of the National Science Foundation. His duties will include administration of the Academic-Year Institutes program as well as curriculum studies in the physical sciences. The Academic-Year Institutes program was inaugurated in 1956 to provide specially designed year-long courses of study for high-school science teachers.

ROBERT M. BURNS, manager of Stanford Research Institute's new European office in Zurich, Switzerland, has established temporary headquarters at the Eden-Au-Lac Hotel in Zurich.

RICHARD T. YATES has been made president of a new company, the Hawthorn Chemical Corporation, formed by Hercules Powder Company and Imperial Chemical Industries, Ltd. The new company will build and operate an $11-million plant for the manufacture of methyl methacrylate.

The plant, with an annual capacity of 35 million pounds, will be built at Louisiana, Missouri, adjoining Missouri Ammonia Works, owned and operated by Hercules. The administrative offices of the company will be located in Wilmington.

For the past 4 months Yates has been on special assignment from Hercules in connection with the formation of Hawthorn Chemical Corporation. Prior to this assignment, he was manager of the Agricultural Chemicals Division, Naval Stores Department of Hercules.

BART J. BOK of Harvard University is being honored by the establishment of a prize fund in his name. The income will be used every 2 years for a prize to a student of Harvard or Radcliffe College who has recently earned the degree of doctor of philosophy in physical sciences.

Bok is leaving the Robert Wheeler Wilson chair of applied astronomy at Harvard this month to direct the Mount Stromlo Observatory of the Australian National University. He first joined the university in 1929.

J. ARTHUR CAMPBELL has resigned from Oberlin College to accept a position as professor and chairman of the chemistry department at the newly established Harvey Mudd College of science and engineering in Claremont, Calif., starting in September 1957. Campbell is at present on leave from Oberlin to serve as program director for summer institutes at the National Science Foundation.

LOWELL T. COGGESHALL resumed his duties on 1 Jan. as dean of the division of biological sciences at the University of Chicago, following his resignation as special assistant to Secretary Folsom of the Department of Health, Education, and Welfare. Coggeshall is president-elect of both the American Cancer Society and the Association of American Medical Colleges.

AIMS C. McGUINNESS of Philadelphia has been chosen to succeed Coggeshall as special assistant for health and medical affairs. McGuinness, a former dean of the University of Pennsylvania Medical Graduate School, recently completed the task of staffing the ten-hospital system of the United Mine Workers welfare and retirement fund. He devoted a year and a half to the project.

GEORGE A. EDWARDS, formerly professor colaborador of the departamento de fisiologia geral e animal of the University of São Paulo, Brazil, has been appointed senior research scientist in micromorphology at the Division of Laboratories and Research of the New York State Department of Health, Albany.

R. H. BRUCK of the University of Wisconsin has received the 1956 Chauvenet prize of the Mathematical Association of America for his paper entitled "Recent advances in the foundations of Euclidean plane geometry," which was published in the *American Mathematical Monthly*.

THOMAS Z. ATKESON of Decatur, Ala., a U.S. Fish and Wildlife Service biologist who lost both hands and was blinded by a land-mine explosion during Army training in World War II, has been nominated by the Department of the Interior as "Handicapped American of the Year." He will receive the President's Trophy, which is presented annually by the President of the United States in conjunction with the meeting of the President's Committee on Employment of the Physically Handicapped.

Atkeson plans and supervises the cooperative farming program for the Wheeler National Wildlife Refuge near Decatur and conducts biological investigations for other refuges in the southeast. He speaks before civic groups, writes articles for local newspapers, and "has been an inspiration in his local community, to employees of the Fish and Wildlife Service and to other handicapped persons."

WALTER C. HESS, chairman of the department of biochemistry in the Georgetown University schools of medicine and dentistry, has been appointed to the university's newly created post of assistant dean for coordination of research at the Georgetown University Medical Center. He will continue as head of biochemistry.

I. S. RAVDIN, John Rhea Barton professor of surgery in the School of Medicine of the University of Pennsylvania and chief surgeon of the University Hospital, was made an honorary fellow of the Royal College of Surgeons, England, in ceremonies held in London on 12 Dec. He was honored after delivering the Moynihan lecture before the Royal College of Surgeons at the Hunterian Museum. The subject of his address was "The complexity of liver disease—surgical steps toward solution."

Ravdin is the 12th American surgeon to deliver this address, and the third American surgeon to deliver the lectureship and to be made an honorary fellow of the Royal College at the same time. Alfred Blalock of Johns Hopkins University and Loyal Davis of Northwestern University have been similarly honored.

Recent Deaths

ANNA M. AGNEW, Brooklyn, N.Y.; 93; former supervising psychiatrist at the Brooklyn State Hospital; 7 Jan.

VINCENT P. BATHA, Waukesha, Wis.; 58; chairman of the physics department at Carroll College; 21 Dec.

LOUIS S. CLARKE, Palm Beach, Fla.; 90; pioneer in the automotive industry and inventor of the first American spark plug; 6 Jan.

JACOB L. DELEVSKY, New York, N.Y.; 88; science writer for the foreign language press and former editor of the French publication *Science*; 3 Jan.

WILLIAM HALL, Rochester, Mass.; 82; professor emeritus of chemistry at Massachusetts Institute of Technology; 3 Jan.

CAROLINE HASLETT, Bungay, Suffolk, England; 61; founder of the Women's Engineering Society and the Electrical Association for Women; 4 Jan.

ARTHUR E. HECKER, Pelham, N.Y.; 65; engineer and former executive of the American Cyanamid Company; 8 Jan.

CHARLES A. C. JOHNSON, Martinsville, N.J.; 68; retired Esso Standard Oil Company engineer; 4 Jan.

GUSTAVE KUECHLER, Forest Hills, N.Y.; 58; engineer, manager of licenses and associated companies for Combustion Engineering, Inc.; 9 Jan.

EUGENE C. MILCH, New York, N.Y.; 54; staff member of the Association for Psychoanalytic Medicine and a lecturer at the New York State College of Medicine at Brooklyn; 8 Jan.

H. J. NICHOLS, JR., Scotch Plains, N.J.; 61; chemical engineer, retired director of the Esso Standard Oil Company; 4 Jan.

ARTHUR L. PARSONS, Toronto, Canada; 83; former head of the department of mineralogy at the University of Toronto; 6 Jan.

PIETRO RONDONI, Milan, Italy; 4 Nov.

AUGUST TINNERHOLM, Scotia, N.Y.; 92; retired electrical engineer; 5 Jan.

WILLIAM H. TWENHOFEL, Orlando, Fla.; 81; retired chairman of the department of geology at the University of Wisconsin; former editor of *The Journal of Sedimentary Petrology*; 4 Jan.

CHARLES-EDWARD A. WINSLOW, New Haven, Conn.; 79; professor emeritus of public health at Yale University; 8 Jan.

JOHN T. ZIMMER, White Plains, N.Y.; 67; chairman of the department of birds of the American Museum of Natural History; 6 Jan.

Reports

Are There Any "Acellular Animals"?

The cell theory, one of the greatest generalizations of biology, has been unwisely attacked. In no uncertain terms, Dobell (*1*) claimed that Protozoa must not be considered as cellular organisms. In fact, he viewed all Protista as noncellular, in spite of "their obvious structural resemblances in certain features" to the cells of Metazoa. More recently, Hyman (*2*) in volume I of her most scholarly and useful series, *The Invertebrates,* has also adopted the view that Protozoa are acellular and has, along with Dobell, defied all the laws of morphological homology and logic in doing so.

Both authors agree that individual Protozoa have the same fundamental organization as is to be found in the cells of Metazoa. Upon what considerations then have these claims of noncellularity been based? Refreshing as views alternative to the customary blind following of current usage have always been to me, I cannot admit the validity of the arguments that Dobell, first, and later, Hyman, have used in their own support, and I wish to show that their interpretation is neither justified nor desirable.

To begin with, Dobell states definitely that the protist individual is not the homolog of a single cell in the body of a multicellular animal or plant, but is instead homologous with a whole multicellular organism. This claim is a contradiction of every valid demonstrable criterion of homology, "morphology's central concept." We say, on the contrary, that because of their essential structural correspondence part for part with the cells of Metazoa, Protozoa are undoubtedly cellular. Thus nuclei are the homologs of nuclei; cytosomes with their constituent parts are each homologs of the corresponding parts of the cells of Metazoa. Indeed, all the major and many of the minor cell parts are recognizable in the cells of many organisms, although the limiting membranes may be temporary or slightly developed in some. There is no useful purpose to be gained by denying these real homologies, and if they exist, a protozoan is the homolog of a single cell in a metazoan.

Dobell and Hyman appear to be in agreement, at least as far as the Protozoa are concerned, that a cell can be a part of an organism, but never a whole organism. This interpretation leads to the strangest conclusions about zygotes and gametes! According to both authors, a fertilized egg is not a cell, but after the first cleavage the two-celled stage is cellular as are all subsequent stages. This is of course a denial of Virchow's aphorism *omnis cellula e cellula,* and the denial is openly made by Dobell. But Hyman's statements are contradictory, for she first affirms Virchow's aphorism and later by implication denies it. Thus on p. 12, Hyman states, "Cells come into being only by the division of preexisting cells," but later (p. 248) it is said that, "No direct proof exists of the origin of the Metazoa from the Protozoa, but such origin, besides being necessitated by the principle of evolution, is strongly indicated by the facts of embryonic development, in which each metazoan passes from an acellular to a cellular condition." Dobell is also in trouble in the case of gametes and parthenogenesis. A gamete of a metazoan is a cell because he interprets it as a part of an organism, not a whole organism. And the unfertilized egg that develops into an organism parthenogenetically is a cell, but the fertilized egg before cleavage is not a cell! This intellectual sleight-of-hand, which is used in order to appear to be consistent, is obviously forced and arbitrary and not at all helpful to their interpretation.

What was hoped for from these illogical conclusions? Dobell wished to emphasize that an individual protist could act as an individual metazoan, which within limits is true. He also wished to make it clear that the Protista are not necessarily simpler, lower, or more primitive than Metazoa. These are challenging statements to which I am entirely sympathetic, and they are worthy of careful consideration. And the view that Metazoa probably became cellular by changes in internal organization, rather than by colonial aggregation as Hadži (*3*) has maintained for some time, I am also willing to accept. But none of these ideas can possibly excuse or justify considering Protozoa to be acellular, nor do they require it.

Hyman explains her interpretation of the Protozoa as "acellular" in the following statements (p. 44). "The study of the invertebrates begins with the Protozoa, animals that are usually defined as consisting of a single cell. This point of view, inherited from the heyday of the dominance of the cell theory in the conception of organisms, which were regarded as aggregations of cells, is not only without advantage, but conveys an erroneous impression. The protozoa are not loose cells moving about, but complete organisms that may be of more complicated construction than the simplest Metazoa. We therefore prefer to refer to the Protozoa as *acellular,* rather than as unicellular animals, that is, as animals whose body substance is not partitioned into cells." This statement has a curious *non sequitur* in it—naturally the body substance of a single cell is not further partitioned into cells, but there is no necessity for denying that it is a cell for that reason. The main reason for denying the cellularity of Protozoa thus appears to be the great complexity of some, and this reason appears to be of more importance to her than the admitted fundamental agreement in structure between protozoan and metazoan cells. "Acellular organisms and the various types of cells found in cellular organisms all exhibit much of the same fundamental construction, and this fact permits the somewhat idealized description of a typical cell found in books" (p. 5).

I suggest that not one of the reasons advanced separately by these authors in support of the interpretation of Protozoa as acellular, nor all of them together, is sufficiently cogent to warrant the denial of the essential homologies that exist in all cells. Nor have any additional reasons been given by Lwoff (*4*) or by Hutner and Provasoli (*5*), who have accepted Dobell's interpretation. There may have been a time when the complexity of some protozoans and the integration of the metazoan individual were underestimated. Even so, every one of the valid objectives of Dobell and of Hyman can be reached without the adoption of their interpretation of Protozoa as acellular. Recent students of the origin of protoplasmic systems—for example, Haldane (*6*)—believe that cellular organization was a necessary step in the evolution of such systems and was early achieved and has been consistently maintained since. Neither the individuality of each protozoan nor the extremes of complexity reached by some requires a denial of

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All technical papers and comments on them are published in this section. Manuscripts should be typed double-spaced and be submitted in duplicate. In length, they should be limited to the equivalent of 1200 words; this includes the space occupied by illustrative or tabular material, references and notes, and the author(s)' name(s) and affiliation(s). Illustrative material should be limited to one table or one figure. All explanatory notes, including acknowledgments and authorization for publication, and literature references are to be numbered consecutively, keyed into the text proper, and placed at the end of the article under the heading "References and Notes." For fuller details see "Suggestions to Contributors" in *Science* 125, 16 (4 Jan. 1957).

their cellularity. In the face of the admitted fundamental agreements in the structures of protozoan individuals and metazoan cells, the arguments advanced by Dobell and by Hyman become irrelevant and of no vital consequence. The cell theory stands as one of the valid generalizations about the protoplasmic systems of animals.

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31 October 1956

Reticular Activating System of Brain Stem and "Animal Hypnosis"

During the evolution of animals and man, certain basic types of reactions to stimuli from the external environment are to be found, the manifestations of which may differ at various evolutionary stages, but whose mechanism is principally identical. These basic types of reactions are called "biological radicals" by Kretschmer (*1*), and their mechanism is considered by this author to be "phylogenetically preformed." Such a biological radical is the so-called "panic reaction" (*Bewegungssturm*); another is the *Totstellreflex,* which is also called "animal hypnosis." The latter phenomenon has a number of analogs in clinical pathology in the form of various manifestations of the stupor-hypnoid syndrome of Kretschmer (*2*).

The onset and the dynamics of "animal hypnosis" as an experimental model of some psychiatric and neurological syndromes have been reported in a number of papers (*3*). In this report, a part of the electroencephalographic analysis of animal hypnosis is brought forward.

Animal hypnosis in a rabbit was experimentally elicited by standard rotation of the animal about its vertebral axis in a special apparatus. After this phenomenon had been evoked, changes characteristic of the onset of sleep and later electric activity of deep sleep appeared in the electroencephalographic record.

When the animal, in a state of animal hypnosis, is exposed to arousing stimuli, then there are changes present in the EEG record that are identical with those produced by arousing stimuli during normal, natural sleep. It is demonstrated in Fig. 1, where the first part of each record represents the wakeful EEG rhythm and the second part represents the rhythm during animal hypnosis, that the applied stimuli (indicated by arrows) lead to a change in the EEG record from the electric activity of sleep to a rhythm of greater frequency and of lower amplitude (record *A,* nociceptive stimulus; *B,* clapping of the hands three times in quick succession; *C,* labyrinth mechanical stimulus; *D,* labyrinth galvanic stimulus). This change can be seen simultaneously in all the electrodes, even though the depression of sleeping activity is not as marked in every electrode. The significance of the arousing stimuli in animal hypnosis is different. Labyrinth stimulation was found to be most effective, with nociceptive, olfactory, acoustic, and optic stimuli following in succession.

The simultaneous appearance of the EEG arousing reaction in animal hypnosis in all the cortical regions at the same time indicates that Magoun's brainstem reticular activating system is capable of function during this inhibitory state. This system represents—in contrast to the classical sensory and sensitive tracts, leading to the primary cortical receptor regions—a secondary afferent tract with a diffuse cortical projection via the thalamic and extrathalamic tract (*4*). The presence of the EEG arousing reaction from animal hypnosis shows that in the course of this form of generalized central inhibition, this system, which is important to the animal's existence and which insures the waking up from sleep, remains functionally active. It is known that, during central inhibition that is evoked, for example, by narcosis, this system is functionally eliminated (*5*).

It is perhaps possible to assume that this observation of the function of one of the most important brain systems during animal hypnosis can contribute toward the elucidation of the mechanism of those human pathological syndromes that appear during regressive forms of human behavior and of which the animal hypnosis represents an experimental model.

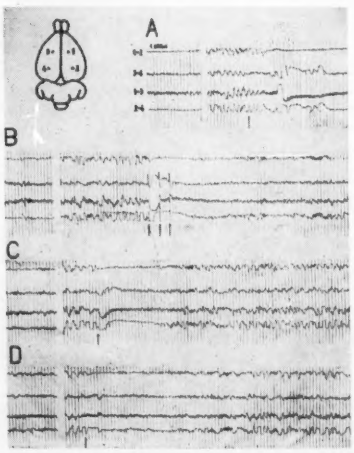

Fig. 1. Electroencephalographic rhythms of animals awake and during "animal hypnosis."

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11 September 1956

Antileukemic Action of Reserpine

During the course of studies in our laboratory on the effect of lysergic acid diethylamide and *d*-amphetamine on the toxicity and marked depression of animals that were administered large (25 mg/kg) doses of reserpine (*1*), we have directed our attention to the metabolic alterations produced by reserpine and reserpine derivatives. Since large doses of reserpine produce marked changes in the normal metabolic patterns (*2*), it was thought possible that reserpine might alter the metabolism of tumor cells more extensively than it did that of normal cells and thereby prove detrimental to the tumor. The data presented here show that reserpine can exert an antileukemic action (*3*).

Hybrid male mice [(BALB/cAn × DBA/2J)F_1] (8 to 10 weeks old and of weight 20 to 25 g) were inoculated in the right hind leg with 0.1 ml of a suspension of leukemic (L1210) cells (*4, 5*). The animals were allowed to develop leukemia until the local tumor had reached a diameter of approximately 9 to 12 mm (estimated by palpation) at which time the disease is generally systemic as well as local. When the disease had reached this preterminal stage, the mice were randomized and the designated groups were treated with a single injection of reserpine. The animals were weighed daily and observed for mortality. The size of the local tumor at the site of leukemic inoculation was obtained by palpation.

The results of a typical experiment are summarized in Fig. 1. A single treatment with reserpine produced an almost threefold increase in the remaining lifetime of mice with advanced leukemia. The mean survival time was an increasing function

of the dose of reserpine administered over the dose range employed (Fig. 1, *A*). Inhibition of the growth of the local tumor was observed consistently in the reserpine-treated mice. Two days after reserpine treatment, the change in the mean tumor diameter was practically nil, even though the tumors of the control (untreated) mice continued to increase in diameter (Fig. 1, *B*). Five days after the administration of reserpine, when all control animals were dead, the change in the mean tumor diameter was an inverse function of the dose of reserpine employed.

Treatment with reserpine frequently appeared to result in complete disappearance of the local tumor at the site of leukemic inoculation. However, transplantation of spleen from several such mice resulted in leukemic growth, indicating that systemic infiltration had not been wholly suppressed. Concomitant with the inhibition of local tumor growth, reserpine also appeared to retard the usual terminal leukocytosis in the peripheral blood.

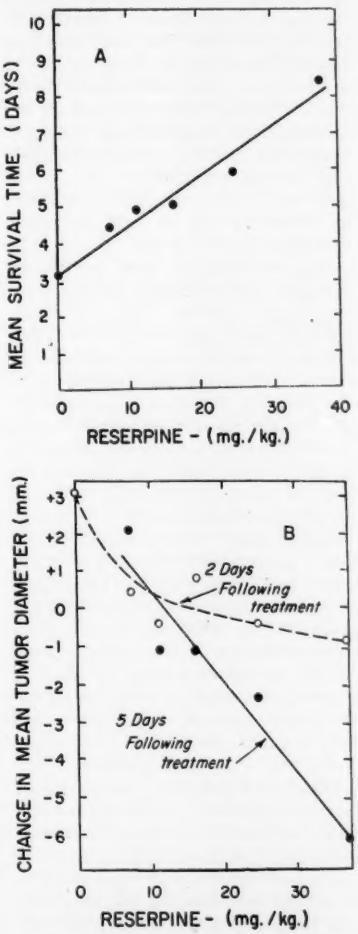

Fig. 1. Dose-response curves for the antileukemic action of reserpine. Reserpine was administered to the mice on the seventh day following inoculation with L1210. The mean survival time shown is the average time, in days, that mice survived after the day of treatment. Each mouse was inoculated with 3.2 million leukemic cells. Groups of ten mice, all with well-developed local tumors (mean tumor sizes ranged from 9.1 to 10.7 mm in diameter) were used for each dose level.

Preliminary experiments indicate that a regime of daily treatment with small doses of reserpine may be superior to treatment with a single large dose of the drug. Other experiments (*6*) have shown that several derivatives of reserpine also possess some antileukemic activity—for example, rescinnamine, deserpedine, and isoreserpine. The vehicle (*7*) used to dissolve the reserpine alkaloids was itself ineffective in inhibiting leukemic growth or in increasing survival time.

The mechanism by which reserpine exerts its antileukemic action is not known. Whether the antileukemic effect is direct or mediated through the host is not clear. Serotonin administration alone did not appreciably influence the course of the leukemia. Overcoming the depression caused by reserpine by administration of *d*-amphetamine did not significantly alter the antileukemic action of reserpine.

At the higher dose levels employed, reserpine-treated animals, both normal and those with leukemia, were severely depressed by the drug and failed to eat or drink for a period of 1 week or longer, and even nonleukemic mice frequently died (of starvation and dehydration?). Drastic loss of weight was invariably observed. Typical data frequently show an average loss of about 30 percent of body weight in 8 days following reserpine administration. Comparable food and water restriction in control animals with advanced leukemia failed to diminish the growth of the local tumors or to increase the survival-time of the mice as compared with untreated controls which received food and water *ad libitum*.

It is generally difficult to increase the survival time of mice with advanced leukemia L1210. Only a few drugs, such as amethopterin (*5*) and 6-mercaptopurine (*8*) have been successful in this respect. Even though reserpine has not been as effective an antileukemic agent as amethopterin, the response of mouse leukemia to treatment with reserpine and several of its derivatives has made available for laboratory study a new group of active antileukemic agents.

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26 November 1956

Infection of Chick Embryos by Crithidia from a Phytophagous Hemipteron

The possibility of a nonvertebrate parasite's infecting vertebrates offers a means of gaining some understanding of the evolutionary processes that are involved in the development of parasitism in vertebrate hosts and as such has attracted the attention of investigators for a number of years. Both negative (*1*) and positive results (*2*) have been reported, and considerable controversy has arisen concerning the correctness of the various results. The present paper (*3*) reports the successful transmission of flagellated protozoans of the genus *Crithidia* from the phytophagous bug *Euryophthalmus davisi* (Barber) to the chick embryo.

Crithidial parasites [possibly *C. euryophthalmi*, McCulloch (*4*)] were obtained from the insect, freed of bacteria by the use of antibiotics, and cultured on N.N.N. media. A luxuriant growth ensued. After a few passages on this medium, the flagellates were grown successfully on a medium consisting of nutrient agar (2 parts) and heparinized duck blood (1 part). On either medium, the crithidial morphology was lost and succeeded by that of a leptomonad.

After the parasites had been 5 days on the modified medium, 1 ml of sterile saline was added to the tube, and several drops of the mixture were placed on the exposed chorioallantoic membrane of 9-day chick embryos. Embryos so treated were placed in an incubator in which a temperature of 30°C ± 2° was maintained. This temperature still supported life in the embryo and more closely approximated the temperature in the hemipteran host.

Five days later, material was withdrawn from the inoculated embryos and examined under a phase microscope. Numerous flagellates were present in the

embryo, and they exhibited evidence of considerable multiplication. In some of the embryos there was a stimulation of the monocytic cell series. In certain phagocytic cells, actively moving protozoans were found (Fig. 1). The motion was so violent at times that the plasma membrane was evaginated by the vigorous punching. The nuclei of such cells were not immune to the motion but were frequently indented and temporarily distorted as a result of the violent action. In most instances, the parasites were only one-half the size of the free individuals and so far as could be told were either without flagella or with very short ones. These forms were similar to leishmania or the "intermediate" forms of Trager (*5*). Parasites were also found in the chorioallantoic fluid and the blood.

Material from the chorioallontoic membrane, the chorioallantoic fluid, and the liver was placed on the modified N.N.N. medium. Five days later, a luxuriant growth was observed in all tubes. No forms were observed in liver preparations that were examined under the phase microscope or in stained smears of the same organ, but that they were present was evidenced by the growth on the cultured material.

Transfers of infected chorioallantoic membranes were made to other chick embryos. A heavy growth took place, and again parasites were detected in phagocytic cells. After survival and multiplication of the parasites had been demonstrated, certain of these embryos were placed in incubators held at 37°C. Parasites continued to be present throughout the life of the embryo (10 days). The parasites are now in their fifth transfer from embryo to embryo at 30°C, and they show no signs of adverse effects due to their existence in the new environment.

Examination of untreated embryos has given no evidence of the forms as described in previous paragraphs. The results were negative when attempts were made to culture material from embryos that had been inoculated with saline or material from sterile culture media or pieces of chorioallantoic membranes from uninoculated embryos. Transfers of the flagellates that have been recovered on cultures from infected embryos have been made and have resulted in infection of the inoculated embryos.

The success of this experiment is, in my opinion, a result of three factors: (i) the extreme adaptability of the crithidia, (ii) the use of the chick embryo as the experimental host, and (iii) the lowering of the temperature of the experimental host. Thus, it may be concluded that, under certain optimal conditions and using techniques that had not been perfected at the time earlier experimenters worked, it is possible for crithidia from

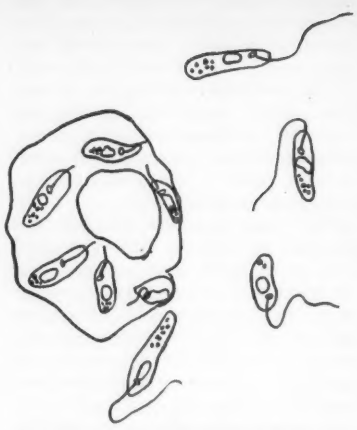

Fig. 1. Camera lucida drawing of a smear of chorioallantoic membrane showing flagellates both free and within a phagocytic cell. Dry film, fixed with methyl alcohol, stained with Giemsa's stain (× 1000).

a phytophagous bug to infect a vertebrate host. It is hoped that future investigations of this phenomenon will shed some light on the little understood subject of evolution of parasites.

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31 October 1956

Homotransplantation of Human Cell Lines

The development of human neoplastic cell lines that can be grown serially in tissue cultures (*1*, *2*) and in heterologous hosts (*3*) has made necessary the investigation of the capacity of such cells to grow in a homologous (human) recipient. Such studies are of fundamental importance to our knowledge of tissue transplantation and host defense mechanisms. In addition, there is the possible danger of initiating neoplastic disease by accidental inoculation during laboratory investigation or by injection with such cells or cell products if they should be used for production of virus vaccine. This article is a preliminary report of a continuing study of (i) the persistence and growth of neoplastic human cell lines after homologous transplantation and (ii) host reactions to such implants.

All recipients were volunteers who were aware of the general purposes of the study and the nature of the implanted materials and who were agreeable to subsequent biopsies (*4*).

Tissue cultures were grown on glass in a mixture composed of 20 percent human serum, 5 percent beef embryo extract, and 75 percent bovine amniotic fluid. Within 4 hours of implantation the cultures were trypsinized, centrifuged lightly, and resuspended in Gey's saline to yield between 3 and 5 million cells per 0.5 ml. This dose was inoculated subcutaneously on the flexor surface of a forearm by tuberculin syringe and a No. 20 needle. When the inoculum was obtained from irradiated and cortisone-treated rats or chick-embryo chorioallantoic membrane (CAM), it consisted of four to six tumor fragments 1 to 2 mm in diameter, and it was implanted through a No. 13 trocar.

All implantations were marked by India-ink tattoos. Usually a single preparation was inoculated at one or two sites, but a few recipients received two to four cell types simultaneously, and one received a total of seven preparations on two occasions. Complete excisional biopsies (*5*) were usually performed as soon as a definitely palpable nodule appeared. In some recent studies, excision was delayed to study duration of growth and the process of regression.

Initial studies were restricted to volunteer patients with advanced incurable cancer and a very short life expectancy. Many had infectious and metabolic complications and chachexia. None had received treatment with steroid hormones, ACTH, marrow-depressing agents such as nitrogen mustard, or x-rays during the three months preceding the studies, and none received any of these treatments during the course of the studies.

Slight local induration and erythema frequently followed inoculations but subsided completely by the third day. Human embryonic fibroblasts with normal cytology were inoculated in three patients. No growth was detected, but neoplastic cells inoculated simultaneously into the same patients did grow. No other normal cells were available for study. Four epithelial cell lines of normal origin (*1*) were inoculated in seven patients, usually produced nodules, and one of these recurred in one patient. These cells cannot be considered normal because they had developed neoplastic characteristics during tissue culture passage, and the nodules were histologically diagnosed as cancer (*6*).

Twenty-four homologous implantations of seven cancer cell lines (originally isolated from cancer tisssues) were made in 14 cancer patients between February 1954 and July 1956. All seven lines (HEp#1, HEp#2, HEp#3, HeLa, HS#1, J-111, Deac 6) multiplied in most of the recipients, as indicated by formation of a palpable nodule at the implantation site and by the finding of healthy cancer cells with active mitoses in the biopsies. In Table 1, only nodules proved by biopsy to contain cancer cells are recorded as positive. Usually the nodule appeared 5 to 10 days after implantation, reached a maximum diameter of ½ to 2 cm in 1 to 2 weeks, and was then excised completely for histologic study.

If they were not immediately excised, the implants usually regressed spontaneously and completely by 4 to 6 weeks. However, in four patients there was recurrence of cancer growth after biopsy at several implant sites. Three of these recurrences were completely removed by a repeat excision on the 19th, 42nd, and 77th days, respectively. In two patients, some of the recurrent nodules grew progressively until the patients died, 42 days and 57 days after the implantations. The latest day on which growth of cancer cells was proved by biopsy is indicated for each recipient in Table 1. Earlier biopsies are not tabulated. All entries at times greater than 35 days are recurrences. In one of these patients, the HEp#3 metastasized to the axillary nodes (Fig. 1*B*). This patient's own cancer was uterine adenocarcinoma, readily distinguished from the implanted cells, and at autopsy was found to be confined to the abdomen and perineum.

Studies to determine whether these homologous cancer cells had a similar capacity for propagation in normal healthy human beings were undertaken at the Ohio State Penitentiary in collaboration with Charles Doan and Richard Brooks and with the cooperation of John Porterfield and R. W. Alvis, warden. From a large group of volunteers, 14 were chosen for the initial study. Methods were identical with the aforementioned ones, except that only tissue cultures were used, and all studies were done simultaneously in June 1956.

There were well-defined differences in the behavior of the implants as compared with those seen in cancer patients. The initial inflammatory reaction was more marked in degree and duration, usually persisting for 1 week or more. The greatest reactions were at HEp#3 implantation sites where (in two patients) sterile abscesses formed. A firm nodule appeared at each site and reached 1 to 3 cm diameter by 14 days. By this time, erythema and edema were subsiding, and one or two nodules were excised from each volunteer. The remaining implants started to regress spontaneously by 3 weeks after implantation and were nonpalpable by 4 weeks. There has been no recurrence in the subsequent 5 months. Histologic sections of all day-14 biopsies showed a marked inflammatory reaction with mononuclear cells predominating. Aggregates of cancer cells (HEp#1, HEp#2, and HEp#3) with mitotic activity were present in only four of the 15 biopsies, and from two of these the cancer cells were reisolated in tissue culture. HeLa cells and Chang's conjunc-

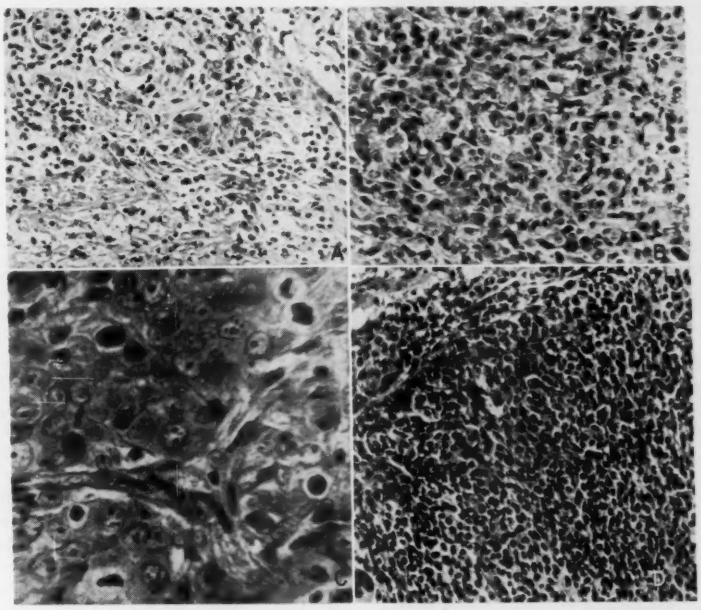

Fig. 1. Biopsies of homotransplants of human cancer cells. Hemotoxylin-eosin stain. *A*, Small aggregates of cancer cells with intense inflammatory reaction; HEp#3 tissue culture in normal volunteer, subcutaneous, 14 days (×80). *B*, HEp#3 tissue-cultured cells metastatic to axillary lymph node 57 days after subcutaneous implantation on forearm of cancer patient (×80). *C*, HeLa cells 18 days after subcutaneous implantation of cells from tissue culture into cancer patient (×350). *D*, HS#1 15 days after subcutaneous implantation in cancer patient; inoculum from cortisone-treated rat (×80).

Table 1. Summary of homotransplantation studies with human cancer cells.

Implanted cells			Cancer patients		Normal volunteers	
Name	Type	Source	Positive/ total*	Latest day of positive biopsy	Positive/ total*	Latest day of positive biopsy
HeLa	Epid. Ca	TC	2/3	14, 18	0/2	
HEp#1	Epid. CA	TC	6/6	7, 19, 21, 34, 42, 77	2/3	14, 14
HEp#2	Epid. CA	TC	2/2	19, 19	1/3	14
HEp#3	Epid. CA	†	6/6	7, 7, 19, 42, 42, 57	1/4	14
HS#1	Fibro SA	Rat	1/1	57		
J-111	Leukemia	TC	3/4	6, 20, 42		
Deac 6	Adeno CA	Hamster	1/1	10		
Conjunctiva	‡	TC	3/6	9, 10, 10, 18, 60	0/3	
Liver	‡	TC	1/3	9		
Kidney	‡	TC	2/2	10, 12		
Appendix	‡	TC	0/1			
Fibroblast	Normal	TC	0/3			

* No. of recipients who had positive biopsies for the presence of the implanted cancer cells/No. of persons who were implanted with the same type of cell.
† HEp#3 in cancer patients includes one from tissue culture, 2 from cortisone-treated rats, and three from chick-embryo chorioallantoic membrane.
‡Cells isolated by Chang (*1*) from normal tissues but showing neoplastic changes in tissue culture (*6*).

tiva cells were not found in these biopsies.

Although it is tempting to postulate that the observed difference in receptivity of cancer cell homografts between normal and cancer patients is related to cancer per se, there is no present evidence against the more plausible explanation that the difference is due merely to the general debility of the cancer patients. However, no consistent differences such as uremia, hematologic abnormalities, or medications can be adduced to explain the apparent weakness of defenses in the cancer patients. Neither did the cancer patients have an "immunologic paralysis" since they did produce antibodies against viruses that were inoculated at about the same time in experimental therapeutic studies. Further studies designed to detect possible differences in cellular and humoral defense mechanisms are in progress.

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4. We, as well as our collaborators, wish to express our appreciation of and admiration for these volunteers, both cancer patients and normal individuals, who, without expectation or possibility of personal gain, have made these studies possible.
5. We are indebted to Arthur James and Richard L. Smyth for surgical assistance and to Robert Mellors, Stephen S. Sternberg, and Helene Wallace Toolan for help in the study of histologic sections.
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10 December 1956

Exchange of Sodium Ion in Ulva lactuca

The exchange of potassium between the cells of the green alga *Ulva lactuca* and the surrounding sea water has been measured previously, using K^{42} as a tracer (*1*). Supporting the evidence previously presented that two separate mechanisms are concerned with sodium and potassium regulation in the organism are the data presented here, which reveal that the kinetics of sodium exchange are entirely different and much more rapid (*2*, *3*).

Ulva collected from Perch Pond, near Falmouth, Mass., was conditioned for at least 24 hours in running sea water under incandescent illumination. Disks 1¾ in. in diameter were cut from a single frond and brought to the correct temperature shortly before each experiment was started. The disks were dipped in sea water containing tracer concentrations of Na^{24} of about 0.5 to 1.0 mc/lit. Then the disks were rinsed in two changes of isotonic sucrose for a total of 30 seconds and blotted three times in absorbent tissue to remove all extracellular potassium and sodium.

Water loss previous to counting was prevented by placing a sheet of parafilm over the counting planchet; counting was done under a Geiger-Müller end-window counter. Cellular sodium was extracted by heating with 1*N* HNO_3 at 110°C for 2 hours. The extracts were then made up to volume in 50-ml volumetric flasks and analyzed for sodium with the Beckman flame spectrophotometer. Samples of sea water (1 ml) were dried in the counting planchet containing a disk of thin paper and moistened to approximate closely the moisture present in a disk of *Ulva*. Specific activities were calculated according to the formula

$$\text{Specific activity} = \frac{\text{counts/min}}{\text{meq/sample}}$$

The data show that after 10 seconds the specific activity of the alga is 92 percent of the specific activity of the sea water when the temperature of the run is 20°C, and after 20 seconds at 1.0°C (Fig. 1). Previous experiments have shown that all extracellular sodium and potassium are removed by the sucrose rinse within 3 seconds (*4*). Other experiments indicate that there is substantially no loss of activity after 30 seconds compared with 15 seconds in sucrose, and only an 8 percent loss after 60 seconds in sucrose. Hence all extracellular sodium must be removed by the sucrose rinse and the triple-blot procedure. It was found also that there is no loss of sodium in the cold.

The presence of the metabolic inhibitor phenylurethane in the radioactive sea water in which the algal disks were dipped had no appreciable effect on the rate of exchange at 20°C. Uranyl ion, which is heavily and preferentially adsorbed on the surface of yeast cells (*2*) also had no appreciable effect on the rate of exchange at 20°C when it was present in a bicarbonate-free artificial sea water containing the Na^{24}.

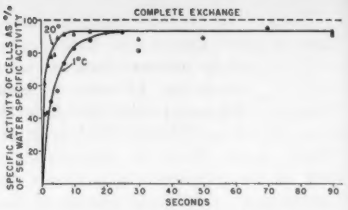

Fig. 1. Exchange of sodium ion in *Ulva lactuca*. Each point represents an average of three samples.

The turnover of sodium as found for *Ulva* is exceedingly more rapid than that found for erythrocytes, requiring only 5 seconds in *Ulva* for 88-percent exchange as compared with 30 hours in human erythrocytes (*5*). In resting giant axon of the squid, complete exchange of sodium takes place in 20 to 30 minutes (*6*).

The existence of a metabolic pump for sodium has been demonstrated for *Ulva* (*4*); its participation in this exceedingly rapid exchange of the majority (92 percent) of sodium is improbable. The data suggest, however, the presence of a small second compartment for sodium, which is presumably within the cell rather than at the surface. Within 90 seconds, temperature caused no determinable difference in the exchange rate of sodium in and out of this second compartment.

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5 December 1956

Book Reviews

Rattlesnakes. Their habits, life histories, and influence on mankind. Laurence M. Klauber. University of California Press, Berkeley, 1956. vol. 1, xxix + 708 pp., vol. 2, xvii + 709–1476. Illus. + plates. $17.50 per set.

The most striking thing about this work is its emphasis on man's relationship to rattlesnakes. While making his numerous highly technical studies of their taxonomy, the author developed a deep interest in the effect that rattlesnakes have had and still have on man; his two volumes fully reflect this interest. An invaluable chapter is devoted to Amerindians and rattlesnakes, one to post-Columbian knowledge of them, and another to myths and other popular beliefs. In addition, the man-rattler relationship appears on innumerable pages because of the author's keen sense of history: he always traces the development of sound knowledge from its beginnings in myth and fancy. For example, the 74-page chapter on the rattle includes an excellent history of the incredibly varied and often ridiculous beliefs about this unique structure. We read that the rattle-a-year belief, first printed in 1615, was seriously questioned as early as 1800. Everyone knows that its death is not yet in sight.

The next characteristics that I want to emphasize are the style and method of exposition. The author is never more technical than necessary, and his style is lucid. He takes little for granted, explaining difficult points as he goes along. The clarity and simplicity, combined with the historical approach, mean that anyone who is the least bit interested in natural history can open the book and read with fascination almost anywhere. The preceding statement is advisedly qualified because certain descriptive sections near the beginning are inherently technical and should be skipped by nonherpetologists. The general reader will find the book more and more interesting as it goes along, whereas the reverse may be true for the herpetologist.

Finally, it should be stressed that *Rattlesnakes* is definitely broader than its title. Time and time again the author goes out of his way to set forth information somewhat remotely connected with rattlesnakes. For example, three pages are devoted to the venomous snakes of the United States other than rattlers, and this discussion even includes the backfanged species, reptiles scarcely dangerous to man. Scores of additional examples could be cited. This breadth makes the two volumes a major, up-to-date source of general information on snakes for both lay reader and student. However, controversial matters often have been dealt with in too great detail, and there is repetition here and there. I believe that shorter discussions and less repetition could have reduced the length enough to have made a wider distribution certain.

The monograph as a whole can be considered to be an encyclopedia of the rattlesnakes, with this qualification: physiology as such is all but omitted, and anatomy is largely confined to structures that are important to taxonomists. Being the product of a single mind, it has a consistency lacking in some of the best encyclopedias.

Besides being one of the two leading students of rattlesnakes, Laurence M. Klauber is a pioneer in the introduction to herpetology of the statistical approach. It is not surprising, then, to find many nicely simplified explanations of statistical methods as applied to snakes. This is no mean contribution in view of the penetration of statistics into every field of science.

The first volume begins with lists of all the known forms of rattlesnakes and includes an abbreviated synonymy of each. Ranges are mapped as well as described verbally. Technical keys of the forms of six appropriate regions promote ready identification; rattlers are notoriously hard to run down in keys, and every aid will be appreciated. No detailed descriptions of species by species are given. Next comes a general account of the morphology, including the long chapter on the rattle. The rest of the volume is devoted to general natural history—such subjects as bodily functions, behavior, population, food, and reproduction are included.

Much of the second volume is a consideration of the poison apparatus and the effects of and treatment for the bite. This gives tehnical information invaluable to physicians, as well as advice that is useful to all persons who live where rattlers or even other vipers abound. Two hundred and eighty-eight consecutive pages deal, for the most part, with the relationship of man to rattlesnakes. (A chapter on legless rattlesnake enemies and those with more than two legs is included here.) It is surprising to learn in the chapter on Amerindians that 62 tribes used arrowheads poisoned with venom or another rattlesnake product. A bibliography of some 3500 titles and an extensive index conclude the book.

Both volumes are well illustrated, and each has a beautiful frontispiece in color. There are half-tone reproductions of portrait photographs of all but four of the twenty-nine known species of rattlesnakes and a great majority of the subspecies. Sixty-eight more half-tone illustrations and 121 line drawings are distributed throughout the work. Sixty-six of the latter are placed in the keys, greatly simplifying their use. A vast amount of information is summarized in 11 graphs and 58 tables.

This unique contribution stands as a monument to the erudition, industry, and literary ability of the author.

CLIFFORD H. POPE
Winnetka, Illinois

Solid State Physics. vol. 2. Advances in research and applications. Frederick Seitz and David Turnbull, Eds. Academic Press, New York, 1956. xii + 468 pp. Illus. $10.

This is the second volume in this series to appear; present plans envision a total of about a dozen. Of the five articles comprising this volume, that by Seitz and Koehler on the displacement of atoms during irradiation accounts for a third of the pages. Seitz and Koehler's discussion is restricted by choice to the effects produced by light charged particles, with only minor mention of neutron collisions. De Launay has contributed an interesting summary of the theory of specific heats and lattice vibrations. He begins with the first theoretical explanation of the Dulong-Petit law and leads up to the present day along a path well paved with elementary derivations and ample comparison with experimental results. The application of neutron diffraction to solid-state problems is discussed by Shull and Wollan. They give an impressive picture of the variety of results on crystal and magnetic structures which have been obtained with this new research tool, which is so definitely "a product of the so-called atomic age."

The remaining two articles cover various aspects of nuclear magnetic resonance. The application of this other relatively new technique to the investi-

gation of electron paramagnetism in metals is ably presented by Knight, who has contributed so much to these developments. Pake's article is a lucid introduction to nuclear magnetic resonance and is long on discussions of relaxation times but short on other types of applications to solid-state problems (for example, one looks in vain for mention of the interesting results on the sublattice magnetization obtained by Poulis in his work on the proton resonance in an antiferromagnetic crystal).

A book like this, however, can be all things to all men. If, by chance, the particular volume contains a good article of special interest to the reader, he will be very pleased; otherwise, the tendency is to ignore entirely a given volume with its heterogeneous collection of articles and return to the less exhaustive but more coherent discussion to be found in a single-volume presentation. One can hope, though, that coherence will appear when the series as a whole is available, although the student will still require a good guide through the maze.

The book appears to have an adequate name and subject index; it is nicely composed and printed, but it has an unimaginative binding which, in my copy, quickly tore loose from the main bulk of the pages.

ROALD K. WANGSNESS
U.S. Naval Ordnance Laboratory

Chemistry and Uses of Pesticides. E. R. de Ong. Reinhold, New York; Chapman and Hall, London, ed. 2, 1956. 334 pp. Illus. $8.75.

As stated in the preface, this book has been rewritten and brought up to date. Numerous references to the literature of 1955 are included. Citations to the literature, rather than the author's knowledge and experience, are the source of authority. The book is a compendium rather than a textbook or treatise, for it considers individual pesticidal active principles as single or pure substances, giving for each something of the chemical and physical properties, the uses for which it has been recommended, and its toxicology and pharmacology.

No important omissions have been noted, and a number of substances that are still considered experimental are mentioned. References to crops and pests are therefore incidental but can be traced through the index. Inorganic compounds are treated in 81 pages; petroleum products in 26; fumigants in 38; derivatives of plants in 30; synthetics in 96; heat, cold, dehydration and radiation in 15; and tolerances and exemptions from the requirements of tolerances of residues in two. Citations grouped at the end of each section are relied on for details of directions not to be expected in a book of this size.

There is no section on the pesticide laws and the requirements of lawful labeling, nor is there one on fertilizer-pesticide mixtures. Since the book relies so much on publications, its reliability can hardly be questioned. It should be more valuable to workers and students with a chemical background than to growers and farmers.

E. L. GREEN
Takoma Park, Maryland

Handbuch der Physik. Band XXXVI. Atome II. S. Flügge, Ed. Springer-Verlag, Berlin, 1956. 424 pp. Illus. DM. 88.

This volume of the famed *Handbuch*'s new edition contains four articles: "Quantum mechanics of the atom" by Friedrich Hund and "Statistical treatment of the atom" by Paul Gombas, both in German, and "Theory of atomic collisions," and "Excitation and ionization of atoms," both in English, by Harrie Stewart Wilson Massey. The authors write from great authority and with careful attention to the latest advances in their fields, but the vast amount of material covered in such review articles makes for a condensed style that demands much study as a prelude to understanding.

In Massey's beautiful article on atomic collisions, enough illustrative detail is provided for the simpler cases of *s*-wave scattering to make clear the essential ideas. It might nevertheless have been more helpful to the student if a few more steps had been provided at the risk of boring the experts. The article is much more general than the title indicates, and the enrichment of the calculational techniques by contributions from workers in nuclear scattering problems is evident throughout.

Massey's second article interweaves in a skillful manner a historical discussion of experimental techniques and results and a comparison with theoretical predictions. The article concludes with a description of applications of excitation and ionization to electric discharges in gases, the aurora, and so forth, thus relating the discussion to other fields.

Hund's article proceeds through a brief historical introduction, leaning heavily on the correspondence principle, to a treatment of the one-dimensional model and the approximations of perturbation theory and the method of Jeffreys (WBK). It is my impression that the emphasis on the correspondence principle is rather heavy despite its historical importance. A description of the periodic system is given; it lists the various quantum state specifications in spectroscopic notation without much discussion of how these things came to be known. However, these criticisms are of minor importance when the article is viewed as a whole, for the article provides a comprehensive summary of the symmetry characteristics of atomic systems from the point of view of group theory, the effect of electron spin, the basis for the vector model, and a discussion of approximation methods, stressing the self-consistent treatment due to Hartree.

The article by Gombas introduces the necessity for a statistical point of view which results from the complexity of the many-body problem. The basis for the treatment of atomic problems in the Fermi-Dirac statistics is noted as applying to electrons, and the simple Thomas-Fermi model is treated. Various corrections to the model such as exchange and relativistic effects are described, as well as the application of the model to the equations of state for extreme pressures and temperatures. Comparisons are made between the results given by the Hartree-Fock method and those of Fermi-Thomas statistical theory, and it is made clear that remarkable agreement between the two points of view is often possible. The general usefulness of the statistical method to questions of molecular structure and of the interaction of gamma radiation with atoms is also indicated. In addition to copious references throughout the Gombas article, an extensive bibliography with references through 1955 is given at the end.

Infrequent typographical errors and failures of the printing to register made for a small amount of confusion.

FREDERICK REINES
Los Alamos Scientific Laboratory

Ninth Annual Report of the Advisory Council on Scientific Policy 1955–1956. Her Majesty's Stationery Office, London, 1956 (order from British Information Services, 30 Rockefeller Plaza, New York 20). 12 pp. $0.14.

In the United Kingdom, the member of the cabinet who is responsible for the formulation and execution of government scientific policy is the Lord President of the Council. On general questions relating to the whole field of civilian science, the Lord President is advised by an Advisory Council on Scientific Policy, which was established in 1947 and is composed of eminent men from the universities, industry, and government. The type of information contained in the annual reports of the council parallels in many instances that to be found in the reports of the U.S. National Science

Foundation—for example, expenditure on research, manpower, and education in the field of science.

During the year under review, the council sponsored two inquiries into scientific manpower. The results of the first inquiry were published in November 1955 under the title *Recruitment of Scientists and Engineers by the Engineering Industry*. This inquiry, carried out by the council's Committee on Scientific Manpower, dealt with the value which firms in the engineering industry attach to different methods of training professional engineers.

The Committee on Scientific Manpower followed up this inquiry with two further studies, the first on the present distribution of scientists and engineers and the second on the likely demands for such persons during the next 10 to 15 years. The first study was a comprehensive statistical survey, carried out by the Ministry of Labour, of the number of scientists and engineers now in industry and of industry's estimate of its expected demands in the coming three years. The committee itself undertook to estimate long-term demands. The results of both these investigations have recently been published jointly by the council and the Ministry of Labour under the title *Scientific and Engineering Manpower in Great Britain*.

Other topics discussed by the council in its current report are availability of Soviet scientific and technical literature, population problems of tropical countries, and the need for an institute of tropical agriculture.

Inhaltsstoffe und Prüfungsmethoden Homöopathisch Verwendeter Heilpflanzen. Herbert Schindler. Editio Cantor, Aulendorf, West Germany, 1955. 231 pp. Illus.

This volume hides a wealth of information behind an unpretentious title. The author has selected 115 plants and described and discussed their medicinal properties. He brings up to date material that has not been compiled since Wehmer's *Die Pflanzenstoffe* was revised during the period from 1929 to 1935.

The comparison with Wehmer's classical work is, of course, qualitative, not quantitative. The plants which Schindler includes in this volume are the ones he considers important in homeopathy. However, he goes far beyond the narrow confines of homeopathic application. His book represents much more than a discussion of drug plants used for this particular purpose. He deals with each plant in such an exhaustive manner that many of the individual chapters could quite well have been published independently. A considerable amount of literature that, to my knowledge, has not been gathered together elsewhere is cited.

Analytic methods are discussed in a concise manner. One is tempted to make a comparison with some of the chapters of another German classic, Klein's *Handbuch der Pflanzenanalyse*. I consider this part of Schindler's contribution of unique value from which the recent publication of Paech's and Tracey's monumental *Modern Methods of Plant Analysis* does not detract. By focusing distinct constituents of pharmacological and pharmacognostical interest and often by discussing them in greater detail, Schindler furnishes a valuable extension of the information given in the handbooks mentioned.

The student of drug plants and plant drugs can hardly afford to overlook Schindler's book. Reading it will prompt him to express the hope that the author may deal with other plant species in a similar manner.

E. H. Lucas

Michigan State University

New Books

Ageing in Industry. An inquiry, based on figures derived from census reports, into the problem of ageing under the conditions of modern industry. F. Le Gros Clark and Agnes C. Dunne. Philosophical Library, New York, 1956. 150 pp. $7.50.

Perspectives in Personality Theory. Henry P. David and Helmut von Bracken. Basic Books, New York, 1957. 435 pp. $6.50.

Franklin and Newton. An inquiry into speculative Newtonian experimental science and Franklin's work in electricity as an example thereof. I. Bernard Cohen. American Philosophical Society, Philadelphia, 1956. 657 pp. $6.

Principles and Problems of Modern Economics. William A. Koivisto. Wiley, New York; Chapman & Hall, London, 1956. 834 pp. $6.

The Structure of a Moral Code. A philosophical analysis of ethical discourse applied to the ethics of the Navaho Indians. John Ladd. Harvard University Press, Cambridge, 1957. 474 pp. $8.

Structure of Rings. American Mathematical Society Colloquium Publ., vol. XXXVII. Nathan Jacobson. American Mathematical Society, Providence, R.I., 1956. 263 pp. $7.70.

Breads, White and Brown. Their place in thought and social history. R. A. McCance and E. M. Widdowson. Lippincott, Philadelphia, 1956. 174 pp. $5.

Fatigue in Aircraft Structures. Proceedings of the International Conference held at Columbia University, 30 Jan.–1 Feb. 1956. Alfred M. Freudenthal, Ed. Academic Press, New York, 1956. 456 pp. $12.

Lymphatics, Lymph and Lymphoid Tissue. Joseph M. Yoffey and Frederick C. Courtice. Harvard University Press, Cambridge, 1956. 510 pp. $10.

Miscellaneous Publications

(Inquiries concerning these publications should be addressed, not to Science, but to the publisher or agency sponsoring the publication.)

Geologic Atlas of Utah, Emery County. Bull. 52. William L. Stokes and Robert E. Cohenour. Utah Geological and Mineralogical Survey, University of Utah, Salt Lake City, 1956. 92 pp. $5.

Studies of the Mississippian Algae. Quarterly of the Colorado School of Mines, vol. 51, No. 4. J. Harlan Johnson and Kenji Konishi. Colorado School of Mines, Golden, 1956. 131 pp. $1.50.

The Manner of Demonstrating in Natural Philosophy. A dissertation. Melvin A. Gultz. Pontifical Faculty of Philosophy, River Forest, Ill., 1956. 184 pp.

Services for Exceptional Children. Proc. of the 1956 Spring Conference, Woods School. Indiana University Medical Center, Indianapolis, 1956. 133 pp.

Franz Joseph Gali, Inventor of Phrenology and His Collection. Wisconsin Studies in Medical History, No. 1. Erwin H. Ackerknecht and Henri V. Vallois. Translated from the French by Claire St. Leon. Dept. of History of Medicine, University of Wisconsin Medical School, Madison, 1956. 86 pp. $1.50.

School Property Insurance. Experiences at state level. Bull. 1956, No. 7. N. E. Viles. 61 pp. $0.25. *Teachers of Children Who Are Blind*. Bull. 1955, No. 10. Romaine P. Mackie and Lloyd M. Dunn. 109 pp. $0.40. U.S. Office of Education, Washington 25, 1956 (order from Supt. of Documents, GPO, Washington 25).

Health and Demography. Halbert L. Dunn. U.S. Public Health Service, Washington 25, 1956. 94 pp.

General Systems, Yearbook of the Society for the Advancement of General Systems Theory. vol. 1. Ludwig Von Bertalanffy and Anatol Rapoport, Eds. Society for the Advancement of General Systems Theory (Mental Health Research Institute, University of Michigan, Ann Arbor).

The Development of Polish Science, 1945–1955. Bogdan Suchodolski and Eugeniusz Olszewski. Polonia Publishing House, Warsaw, 1956. 91 pp.

Some Protozoan Diseases of Man and Animals: Anaplasmosis, Babesiosis, and Toxoplasmosis. Annals of the New York Academy of Sciences, vol. 64, No. 2. 253 pp. *Calcium and Phosphorus Metabolism in Man and Animals with Special Reference to Pregnancy and Lactation*. vol. 64, No. 3. 184 pp. *Effects of Natural Selection on Human Genotypes*. vol. 65, No. 1. 32 pp. *Epidemic and Endemic Diarrheal Diseases of Infants*. Annals of the New York Academy of Sciences, vol. 66, No. 1. 228 pp. Kenneth T. Morse, Ed. New York Academy of Sciences, New York, 1956.

On the Cell Model for Solutions. Annals of the New York Academy of Sciences, vol. 65, No. 2. 22 pp. Stuart A. Rice. New York Academy of Sciences, New York, 1956.

Studies on Seed-Setting and Seed Yield in Oil Flax. Meddelande Fran Gullakers Vaxtforadlingsanstalt, Hammenhog, Nr. 12. Rolf Manner. Meddelande Fran Gullakers Vaxtforadlingsanstalt, Hammenhog, 1956. 139 pp.

Meetings and Societies

Electron Microscopy

The first Regional Conference on Electron Microscopy in Asia and Oceania was held in Tokyo, 23–27 Oct., under the auspices of the International Federation of Electron Microscope Societies. The conference was efficiently arranged by the Japanese Society of Electron Microscopy with the support of the Science Council of Japan and the Ministry of Education. The meetings were held in the International Conference Auditorium of the ultramodern Sankeikaikan, which affords excellent facilities for multilingual conferences. English was the official language, but many of the papers were presented in Japanese or German, which were interpreted through earphones with a channel selector provided at each seat. The delegates from the U.S.S.R. brought their own interpreter, who read their papers in English. Both the organization and the physical facilities of the conference were excellent, and the organizing committee deserves highest commendation for its splendid work.

The 200 delegates included two from Germany, six from the U.S.S.R., five from China, two from India, two from Indonesia, two from Cambodia, and four from the United States.

The conference was appropriately opened by a review of the history of the electron microscope by one of its original designers, Ernst Ruska, director in the Fritz-Haber-Institute of the Max-Planck-Society, Berlin, whose advances in the field continue to be reflected in high-quality electron microscopes produced by the Siemens Company. Fourteen of the 54 papers presented dealt with electron optical theory and instrumentation, mostly from Japan and Germany; 18 with industrial products, including investigations of rubbers, metals, fibers, and inorganic crystals; and 22 with biological applications. In both Japan and Germany investigators are concerned with damage to specimens caused by the electron beam and are extensively investigating the relationship of temperature to the amount of damage. Cooling the specimen diminishes the damage.

V. G. Nyrikov, director of the Institute of Electron Optics of the Ministry of Radiotechnical Industry, Moscow, reported on the development of electron microscopes in Russia. At present there are about 400 of four different types in use, one of them employing electrostatic, rather than magnetic, lenses. The best resolution claimed with the large 100-kilovolt instrument was a rather conservative 30 angstroms; however, a new instrument is under construction which is designed to resolve to about 10 angstroms. As is the case in other fields, the principal retardation to progress in the biological field lies not in instrumentation but in the preparation of materials —fixation, imbedding, thin sectioning, and so forth. In Japan and in India there has been extensive development of ultrathin sectioning techniques, and several papers indicated a high level of electron microscopy.

Along with the scientific and industrial recovery of Japan since World War II, there has evolved a keen interest in the design and development of complex scientific instruments. This trend is well exemplified in the development of electron microscopes. There are at present four different companies manufacturing eight different types or models of electron microscopes ranging widely in complexity and versatility and priced from about $3000 to $25,000. Three hundred of these instruments are in use in Japanese laboratories, a number that represents a remarkable percentage of the world's estimated 1800 instruments.

Two of the instruments probably deserve special mention because of their novelty and simplicity. One, manufactured by Akashi, uses as an electron source a pointed platinum (oxidized) filament without a condenser lens and obtains sharp images at a resolution down to about 25 angstroms. The other, produced by Hitachi, utilizes permanent, instead of electro-, magnets for its lenses and varies their strength by movable shunting rings. This obviates the necessity of carefully regulated lens current power supplies. This instrument also provides a resolution of 25 to 30 angstroms and permits a wide and continuous range of magnification. The simplicity, compactness, low cost, low upkeep, and reasonable resolution would seem to recommend these microscopes for many purposes.

The complete proceedings of the conference, a volume of 150 to 200 pages will be available in about 6 to 8 months and can be obtained through the conference secretary, Dr. K. Kanaya, Electrotechnical Laboratory, 2 chome, Nagata-cho, Chiyoda-ku, Tokyo, Japan.

DAN H. MOORE
Department of Microbiology, College of Physicians and Surgeons, Columbia University, New York, N.Y.

Aeronautical Sciences

The Institute of the Aeronautical Sciences 25th annual meeting will be held 28–31 Jan. at the Sheraton-Astor Hotel, New York. A record 94 technical papers will be delivered. One technical session for each year the IAS has been in existence has been arranged. Among the 25 will be one each on missiles and earth satellites, three on aerodynamics, and two on materials. Sessions will be held simultaneously.

Edward P. Curtis, special assistant to President Eisenhower for aviation facilities planning, will be guest of honor and principal speaker at the Honors Night Dinner on 28 Jan. Toastmaster Edward R. Sharp, retiring IAS president, will present the John Jeffries, Robert M. Losey, Sylvanus Albert Reed, and Lawrence Sperry awards. Registration at the 1956 annual meeting was 2179.

Society for Social Responsibility

The Society for Social Responsibility in Science will meet on 1 Feb. from 4:30 to 6:30 P.M. at the Hotel New Yorker in New York. A series of papers on the role of the scientist in society will be presented. Interested scientists are invited to attend. A dinner at a nearby restaurant will follow the meeting. For further information, communicate with Reino Hakala, Department of Chemistry, Fairfield University, Fairfield, Conn.

Radiation Hazards

A Symposium on Radiation Hazards to Mankind, sponsored jointly by Hunter College and the Sloan-Kettering Institute for Cancer Research, will be held at Hunter College on 20 Feb. from 3:45 to 10 P.M. Warren Weaver of the Rockefeller Foundation will open the sessions, and the rest of the afternoon will be devoted to two panels that will consider "Implications for graduate study and for the training of college faculties" and "Implications for the secondary-school curriculum and for the training of secondary-school teachers."

A large general session in the evening will be concerned with "Biological effects of atomic radiation." Participants include among others: James F. Crow of

the University of Wisconsin, George Gamow of the University of Colorado, Russell Morgan of Johns Hopkins Hospital, and Lauristan Taylor of the National Bureau of Standards. Lyman Bryson will act as moderator. Morris Meister, principal of the Bronx High School of Science; I. E. Wallen, assistant director of the AAAS Science Teaching Improvement Program; and Abraham Raskin, coordinator of the sciences for the Teacher Education Program, Hunter College, will participate in the afternoon session.

To receive invitations to any of these meetings, write to Prof. Ruth G. Weintraub, Director of Graduate Study in Arts and Sciences, Hunter College, 695 Park Ave., New York 21, N.Y.

Society Elections

■ Indiana Academy of Science: pres., Willis H. Johnson, Wabash College, Crawfordsville; v. pres., W. A. Daily, Eli Lilly and Company; sec., Harry E. Crull, Butler University, Indianapolis; treas., Frank J. Welcher, Indiana University.

■ Sigma Delta Epsilon: pres., Irene C. Diller, Institute for Cancer Research; 1st v. pres., Mary L. Robbins, George Washington University; 2nd v. pres., Esther S. Anderson, University of Nebraska; sec., Helen B. Parker, 7 Lloyd Road, Malvern, Pa.; treas., Teresa Cohen, Pennsylvania State University. Representatives to the AAAS Council are Irene C. Diller and Mary Gojdics.

■ American Fern Society, Inc.: pres., Ira L. Wiggins, Stanford University; v. pres., Harold G. Rugg, Dartmouth College; sec., Mildred E. Faust, Syracuse University; treas., Ronald L. McGregor, University of Kansas.

■ American Astronautical Society, Inc.: pres., Ross Fleisig, Sperry Gyroscope Company; treas., William C. Thacher, Nassau-Bahamas Development Board; rec.-sec., Joseph M. Golden, RCA Communications, Inc.; cor.-sec., A. P. Mayernik. The vice presidents are George R. Arthur, James E. Michaels, and James H. Rosenquist.

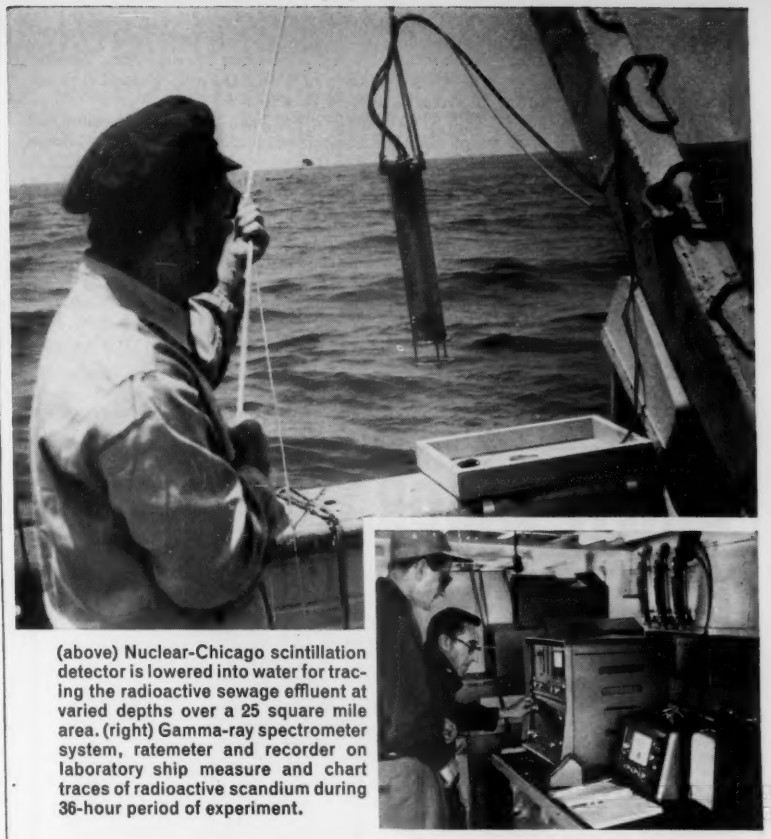
Forthcoming Events

February

21–23. National Soc. of College Teachers of Education, annual, Chicago, Ill. (C. A. Eggertsen, School of Education, Univ. of Michigan, Ann Arbor.)

23. American Mathematical Soc., New Haven, Conn. (J. H. Curtiss, AMS, 190 Hope St., Providence 6, R.I.)

23. Oregon Acad. of Science, annual, Monmouth. (F. A. Gilfillan, Oregon State College, Corvallis.)



(above) Nuclear-Chicago scintillation detector is lowered into water for tracing the radioactive sewage effluent at varied depths over a 25 square mile area. (right) Gamma-ray spectrometer system, ratemeter and recorder on laboratory ship measure and chart traces of radioactive scandium during 36-hour period of experiment.

RADIOACTIVITY HELPS PREVENT BEACH POLLUTION FROM SEWAGE EFFLUENT

In a unique experiment just completed in Santa Monica Bay, California, radioactive isotopes were successfully used to trace the dispersion of sewage effluent in ocean waters. The results are helping to establish proper design procedures to insure against beach pollution in a current expansion of the Los Angeles sewage system.

The tracer experiment was a joint project of Hyperion Engineers, Nuclear Science and Engineering Corporation and the Hancock Foundation of the University of Southern California. Twenty curies of scandium-46 were mixed with sewage effluent and discharged into the sea. Scientists aboard a laboratory ship then took radioactive measurements over a wide area to determine dilution rate and direction of diffusion.

Since this was a "one-shot" experiment, the dependability and overall sensitivity of the equipment were extremely important. The instruments chosen, including the DS5-3 scintillation detector, 1810 gamma-ray spectrometer, 181 scaler and 1620 ratemeter were standard Nuclear-Chicago catalog items.

nuclear-chicago

NUCLEAR INSTRUMENT AND CHEMICAL CORPORATION
237 West Erie Street, Chicago 10, Illinois
LEADERS IN MAKING RADIOACTIVITY COUNT

24–28. American Inst. of Mining, Metallurgical and Petroleum Engineers, annual, New Orleans, La. (E. O. Kirkendall, AIME, 29 W. 39 St., New York 18.)

24–28. International College of Surgeons, 10th biennial cong., Mexico, D.F., Mexico. (M. Thorek, ICS, 850 W. Irving Park Rd., Chicago 13, Ill.)

25–28. American Soc. of Heating and Air-Conditioning Engineers, Chicago, Ill. (A. V. Hutchinson, ASHAE, 62 Worth St., New York 13.)

26–28. Western Joint Computer Conf., Los Angeles, Calif. (M. J. Mendelson, Norden-Ketay Corp., 13210 Crenshaw Blvd., Gardena, Calif.)

March

1–2. American Physical Soc., Norman, Okla. (K. K. Darrow, Columbia Univ., New York 27.)

1–3. National Wildlife Federation, annual, Washington, D.C. (C. H. Callison, 232 Carroll St., NW, Washington 12.)

3–6. American Inst. of Chemical Engineers, White Sulphur Springs, W.Va. (F. J. Van Antwerpen, AIChE, 25 W. 45 St., New York 36.)

3–9. American Soc. of Photogrammetry, 23rd annual, joint with American Cong. on Surveying and Mapping, 17th annual, Washington, D.C. (C. E. Palmer, ASP, 1515 Massachusetts Ave., NW, Washington 5.)

4. Wildlife Soc., annual, Washington, D.C. (D. L. Leedy, Fish and Wildlife Service, Dept. of the Interior, Washington 25.)

4–6. National Biophysics Conf., Columbus, Ohio. (H. P. Schwan, School of Medicine, Univ. of Pennsylvania, Philadelphia 4.)

4–8. Analytical Chemistry and Applied Spectroscopy, Pittsburgh, Pa. (L. M. Melnick, U.S. Steel Corp., Applied Research Lab., Monroeville, Pa.)

7–9. American Orthopsychiatric Assoc., 34th annual, Chicago, Ill. (M. F. Langer, AOA, 1790 Broadway, New York 19.)

7–9. Biometric Soc., Eastern North American Region, Washington, D.C. (A. M. Dutton, Box 287, Sta. 3, Rochester, N.Y.)

7–9. Fundamental Cancer Research, 11th annual symp., Houston, Tex. (L. Dmochowski, M. D. Anderson Hospital, Texas Medical Center, Houston 25.)

7–9. Optical Soc. of America, semiannual, New York, N.Y. (S. S. Ballard, Scripps Inst. of Oceanography, San Diego 52, Calif.)

10–16. Nuclear Engineering and Science Cong., 2nd, Philadelphia, Pa. (Engineers Joint Council, 29 W. 39 St., New York 18.)

11–15. National Assoc. of Corrosion Engineers, 13th annual, St. Louis, Mo. (R. T. Effinger, Shell Oil Co., Deer Park Refinery, Houston, Tex.)

11–18. Pakistan Assoc. for the Advancement of Science, 9th annual conf., Peshawar, West Pakistan. (B. Ahmad, PAAS, University Institute of Chemistry, The Mall, Lahore, Pakistan.)

12–13. Cellular and Humoral Aspects of the Hypersensitive States, symp., New York, N.Y. (A. M. Pappenheimer, Jr., Dept. of Microbiology, New York Univ., College of Medicine, 550 First Ave., New York 16.)

13–15. Society of Exploration Geophysicists, 10th annual midwestern, Fort Worth, Tex. (G. A. Grimm, Tide Water Associated Oil Co., Box 2131, Midland, Tex.)

14. Effect of Radiation on Foods, Assoc. of Vitamin Chemists, Chicago, Ill. (M. Freed, Dawe's Laboratories, Inc., 4800 S. Richmond St., Chicago 32.)

15. Fats in Human Nutrition, AMA symp., New Orleans, La. (Council on Foods and Nutrition, American Medical Assoc., 535 N. Dearborn, Chicago 10, Ill.)

18–21. Institute of Radio Engineers, natl. convention, New York, N.Y. (B. Warriner, IRE, 1 E. 79 St., New York 21.)

19–21. American Meteorological Soc., 151st national, Chicago, Ill. (K. C. Spengler, AMS, 3 Joy St., Boston 8, Mass.)

20–22. National Health Forum, Cincinnati, Ohio. (National Health Council, 1790 Broadway, New York 19.)

20–23. National Science Teachers Assoc., annual, Cleveland, Ohio. (R. H. Carleton, NSTA, 1201 16 St., NW, Washington 6.)

21–23. American Physical Soc., Philadelphia, Pa. (K. K. Darrow, APS, Columbia Univ., New York 27, N.Y.)

(*See issue of 18 January for comprehensive list*)

2 NEW LABORATORY AIDS!

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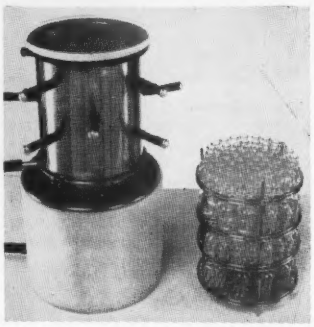

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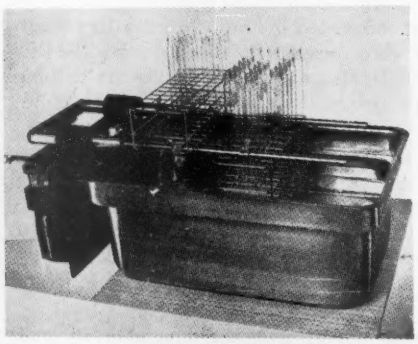

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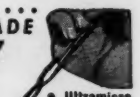

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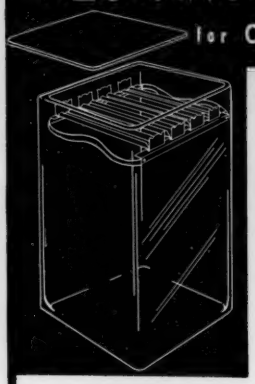

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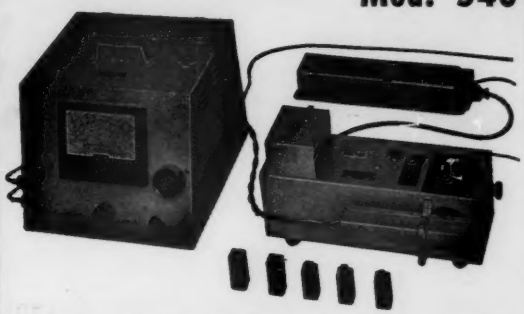

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RANGE: 2 to 12 pH (readable to 0.1 pH)
POWER: 6 standard batteries (400 hours)
SIZE: 3" x 6" x 2"
WEIGHT: 2 lbs.

Beckman POCKET pH METER

For quick, accurate measurement of acidity or alkalinity, use this new *pocket-sized* pH meter. It features a single combination electrode that can be left attached to the instrument when in use. You can take a pH reading with one hand . . . record the data with the other!

Complete operating instructions are printed on the back of the meter. It's easy to use. There are no bottles or beakers to spill. The non-spill plastic tube with sponge holds enough buffer for a day or more. Power is supplied by six easily replaced batteries of the type used in flashlights and hearing aids.

The handsome 2-tone gray case is molded of tough, acid-resistant melamine plastic. The dial face is made of scratch-resistant polystyrene. Circuit incorporates many design features found in more expensive laboratory instruments.

For complete information, write for bulletin S-700.

H-36000 Beckman Pocket pH Meter, Model 18000, with electrode, plastic buffer container, bottle of buffer solution, bottle of KCl crystals for refilling electrode, box of paper tissues for drying electrode. Complete price $95.00

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